

# **Radiation Protection (Ionising Radiation) Regulations**

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**PART I**

## PRELIMINARY

### Citation

1. These Regulations may be cited as the Radiation Protection (Ionising Radiation) Regulations.

### Definitions

2. In these Regulations, unless the context otherwise requires —

“absorbed dose” means the amount of energy, expressed in gray, imparted to matter by ionising radiation per unit mass of the irradiated material at the place of interest;

“annual limit on intake” or “ALI” means the activity of a radionuclide which, if taken alone into the human body, would irradiate an individual to the dose limit specified in Part I of the Second Schedule;

“approved” means approved in writing by the Chief Executive;

“becquerel” means the unit of radioactivity defined as one disintegration per second, and may be designated by the symbol “Bq”;

“committed effective dose” means the time integral of the effective dose rate following an intake of radioactive material into the body based on —

(a) the time period that has elapsed after the intake; and

(b) if the time that has elapsed after the intake is not known, the time period shall be deemed to be 50 years for an intake by an individual of 18 years of age or above and a time period of up to his attainment of 70 years of age for an intake by an individual below 18 years of age;

“effective dose” means the sum of the weighted equivalent doses in all tissues and organs of the human body;

“equivalent dose” means the sum of the product of the absorbed dose in gray and the radiation weighting factor for all the different types of radiation incident on a tissue or an organ, and is expressed in sievert;

“full blood examination” means —

(a) an estimation of the haemoglobin in grams per 100 millilitres of whole blood;

- (b) an estimation of the number of red blood cells present per cubic millimetre of whole blood;
- (c) an estimation of the number of white blood cells present per cubic millimetre of whole blood;
- (d) a differential white cell count;
- (e) a platelet count;
- (f) a search for abnormal cells and description of any seen; and
- (g) any other blood examination as the Chief Executive may from time to time require;

“gigabecquerel” means one thousand million becquerels and may be designated by the symbol “GBq”;

“gray” means the unit of absorbed dose and is equal to one joule per kilogramme of irradiated material and may be designated by the symbol “Gy”;

“individual” means any natural person;

“installation” means the area of radiation hazard under the administrative control of the person possessing the source of radiation;

“ionisation chamber smoke detector” means a detector, using radioactive materials, sensitive to combustion products capable of affecting ionisation currents within the detector;

“irradiating apparatus” means —

- (a) any apparatus that is capable of producing ionising radiation; or
- (b) any component of or accessory to an apparatus described in paragraph (a);

“kilobecquerel” means one thousand becquerels and may be designated by the symbol “kBq”;

“leakage radiation” means all radiation other than the useful beam;

“licensee” means a person who holds a licence under the Act;

“megabecquerel” means one million becquerels and may be designated by the symbol “MBq”;

“microsievert” means one millionth part of a sievert and may be designated by the

symbol “ $\mu\text{Sv}$ ”;

“millisievert” means one thousandth part of a sievert and may be designated by the symbol “ $\text{mSv}$ ”;

“non-single station ionisation chamber smoke detector” means an ionisation chamber smoke detector which is intended for, and capable of, connection to one or more other smoke detector units as part of a fire detection system with a centrally located alarm and power supply unit;

“primary radiation” means radiation coming directly from any radioactive substances or irradiating apparatus;

“radiation” or “ionising radiation” means energy that is propagated in the form of X-rays, gamma-rays, alpha and beta particles, high speed electrons, neutrons, protons and other nuclear particles, but does not include energy in the form of sound and radiowaves, or visible, infra-red, or ultra-violet light;

“radiation dose” means effective dose or equivalent dose received by an individual;

“radiation hazard” means the danger to the health of an individual arising from exposure to ionising radiation, whether due to external radiation or to radiation from radioactive substances within the body;

“radiation level” means the corresponding equivalent dose rate;

“radiation weighting factor” means a dimensionless factor, selected for the type and energy of radiation incident on the body or from sources within the body, by which the absorbed dose in a tissue or an organ is weighted to give the equivalent dose;

“radiation work” means work which —

- (a) involves the use or handling of any radioactive substance;
- (b) involves the use or operation of any irradiating apparatus; or
- (c) is required to be carried out in proximity to any irradiating apparatus or radioactive substance or both,

and which is liable to result in the receiving by the individual engaging in it of a radiation dose in excess of one-tenth of the appropriate dose limit for radiation workers as specified in Part I of the Second Schedule;

“radiation worker” means any individual who is engaged in or is employed for part or whole or his working time to do radiation work;



“scattered radiation” means radiation which, during its passage through a substance —

(a) has been deviated in direction; or

(b) has been modified by an increase in wave length;

“sealed source” means any radioactive material that is firmly bonded within material or sealed in a capsule of adequate mechanical strength so as to prevent the escape of any part of the radioactive material under foreseeable conditions of use and wear but so designed as to allow the emission of ionising radiation for use as required;

“secondary radiation” means radiation other than primary radiation that is emitted by any matter irradiated by primary radiation;

“sievert” means the unit of equivalent dose and may be designated by the symbol “Sv”;

“single station ionisation chamber smoke detector” means a self-contained ionisation chamber smoke detector in which the alarm is incorporated in the ionisation chamber smoke detector itself and which does not need to be linked to any other external fire detection or alarm system in order to function;

“specific activity”, in relation to —

(a) a radionuclide, means the activity of the radionuclide per unit mass of that nuclide; and

(b) a material in which the radionuclides are essentially uniformly distributed, means the activity per unit mass of the material;

“stochastic effects” means those effects for which the probability of an effect occurring, regarded as a function of dose, is without threshold;

“tissue weighting factor” means the proportion of the risk arising from stochastic effects resulting from tissue to the total risk, when the whole body is irradiated uniformly;

“transfer record” means a record prepared on the termination of any individual’s employment of radiation dose received by him being a record prepared in accordance with requirements for the time being imposed under these Regulations;

“unsealed source” means any radioactive material which is not a sealed source;

“useful beam” means that part of the primary and secondary radiation that passes

through the aperture, cone or other device for collimating the beam.

## PART II

### EXEMPTIONS

#### Exemptions

**3.—(1)** The provisions of the Act shall not apply to any import, export, possession, manufacture, transport, use, disposal, sale of or other dealing in the following radioactive substances:

- (a) a natural radioactive substance of any equivalent specific radioactivity not exceeding that of natural potassium; and
- (b) a radioactive substance having an activity or activity concentration not exceeding that prescribed in the First Schedule with respect to the particular radionuclide unless it is used for medical purposes, is intentionally added to foodstuffs, fertilisers, pharmaceutical goods, cosmetics or toys, or is to be disposed of as radioactive waste.

(2) Any educational institution which has in its possession or under its control any radioactive substance, being a sealed source, not exceeding 100 times the activity or activity concentration prescribed in the First Schedule with respect to that particular radioactive substance, and any teacher designated under this paragraph, shall be exempted from sections 5(1)(b) and (d) and 6 of the Act if—

- (a) the radioactive substance is used or to be used solely for demonstration, teaching or research purposes in the educational institution;
- (b) the radioactive substance is under the control of a competent teacher designated by the principal in the case of a secondary school, or by the head of the relevant department, in the case of a university, polytechnic or college, to take full responsibility for the safe storage and use of such radio-active substance and for the compliance with the relevant provisions of these Regulations relating to a sealed source; and
- (c) the name of the teacher designated in accordance with sub-paragraph (b) and the complete details of the radioactive substance are submitted to the Chief Executive.

(3) Any person who has in his possession or under his control not more than 3 sealed sources, each of which contains any radioactive substance not exceeding 175 kBq, for the sole purpose of checking or calibrating a particular radiation survey or monitoring

instrument shall be exempted from sections 5(1)(b) and (d) and 6 of the Act if the complete details of the radioactive substance are submitted to the Chief Executive, except that the person shall be responsible for the safe storage and use of the radioactive substance and for compliance with the relevant provisions of these Regulations relating to a sealed source.

(4) The Act and all regulations made thereunder (except Parts XIII and XV of these Regulations) shall not apply to —

- (a) any radioactive substance which is implanted in or has been internally administered to an individual for medical purposes; and
- (b) any such implant of a permanent nature which has been notified to the Chief Executive with such other information as he may require.

(5) Any person having the control or management of a single station or non-single station ionisation chamber smoke detector containing a sealed source shall be exempted from sections 5 (1)(b) and (d) and 6 of the Act, and from regulations 26 and 29 if the ionisation chamber smoke detector complies with the recommendations of the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development or any other equivalent international standards and recommendations.

(6) Section 6 of the Act shall not apply to any registered or enrolled student of an educational institution who, in the course of his studies, performs any experiment or carries out any research involving the handling or use of any irradiating apparatus or radioactive materials under the direct supervision of a licensee authorised to conduct such experiment or research.

(7) The provisions of the Act shall not apply to the import, export, possession, use or sale of or other dealing in the following articles or irradiating apparatus:

- (a) any timepiece, instrument, or device containing self-luminous elements, except during the manufacture or repair of the self-luminous elements themselves and providing the timepiece, instrument or device contains no more than —
  - (i) 35 kBq of radium-226, 105 kBq of americium-241, 70 MBq of promethium-147 or 3.5 GBq of tritium, where the luminescent substance is substantially insoluble in water and is in the form of glass, vitreous enamel or similar substance or in the form of a paint or film which adheres to the timepiece, instrument or device during normal use; or
  - (ii) 70 GBq of tritium or 9 GBq of krypton-85 in the form of

radioactive gas;

- (b) any electrical equipment, other than equipment referred to in paragraph (c), which is not primarily intended to produce ionising radiation (such as cathode ray tubes, transmitting valves, rectifying valves, image converters and television tubes) and which does not produce a radiation level of more than 5  $\mu$ Sv per hour at a distance of 5 centimetres from any accessible surface; or
- (c) any Video Display Unit or domestic-type television set or television equipment used for projection purposes, closed circuit applications and the like which conforms to the standards of the International Commission on Radiological Protection or any other equivalent international standards or recommendations.

(8) Notwithstanding sub-paragraphs (b) and (c) of paragraph (7), the provisions of the Act shall apply to the testing or servicing, in the course of production, of the equipment specified in those sub-paragraphs.

### PART III

### LICENCES

#### **Application for licence**

4.—(1) Every application for a licence or for renewal thereof shall be made to the Chief Executive in such form as he may require.

(2) Any individual applying for a licence to use irradiating apparatus or to use, handle and transport radioactive materials shall submit together with his application to the Chief Executive —

- (a) evidence that he has within 12 months immediately before his application undergone a medical examination by an approved registered medical practitioner, which shall include a full blood examination and any other examination as the Chief Executive may require; and
- (b) a certificate by an approved registered medical practitioner stating that the individual is fit to be engaged in radiation work.

#### **Licence fees**

5.—(1) Except as provided in paragraph (3), the following fees shall be payable for

every issue or renewal of a licence:

<i>Application Reference</i>	<i>Type</i>	<i>Fee</i>
L1	to manufacture, possess for sale or deal in irradiating apparatus	\$210 per annum
L2	to manufacture, possess for sale or deal in radioactive materials	\$210 per annum
L3	to keep or possess an irradiating apparatus for use (other than sale)	\$155 per annum
L4	to keep or possess radioactive materials for use (other than sale)	\$155 per annum
L5	to use irradiating apparatus (other than sale)	\$145 per annum
L6	to use, handle and transport radioactive materials (other than sale)	\$145 per annum
L6A	to handle and transport radioactive materials	\$155 per annum
L7	to import or export a consignment of irradiating apparatus	\$40 per consignment
L8	to import or export a consignment of radioactive materials	\$40 per consignment

(2) Every licence issued pursuant to an application bearing application reference L1, L2, L3, L4, L5, L6 or L6A shall be for a period of 3, 6, 9, 12 or 24 months.

(3) Where a licence is to be issued for a period of less than 12 months, the fee payable for such licence shall be such proportion of the fee specified in paragraph (1) for such licence as the number of calendar months of that period bears to a period of 12 months.

(4) A separate licence to keep or possess irradiating apparatus shall be required for each irradiating apparatus.

(5) Any fee paid for an application for the issue or renewal of any licence under this regulation shall not be refundable.

(6) An individual who is the holder of a licence issued pursuant to an application bearing application reference L5 or L6 shall be entitled to personal monitoring service provided by the Chief Executive during the period of validity of his licence.

## Purpose of licence

6.—(1) Licences may be granted for medical diagnostic, medical therapeutic, dental diagnostic, veterinary diagnostic and for industrial, experimental, testing, demonstration or research purposes or such other specified purposes as may be approved by the Chief Executive.

(2) The Chief Executive may grant a licence —

- (a) to use irradiating apparatus for medical diagnostic purposes only if he is satisfied that the applicant is a diagnostic radiologist;
- (b) to use irradiating apparatus for any specific medical purpose only if he is satisfied that the applicant is a registered medical practitioner who, in his opinion, has special knowledge of the safe use of such irradiating apparatus for that specific purpose;
- (c) to use unsealed sources for medical diagnostic purposes only if he is satisfied that the applicant is a nuclear medicine specialist or a registered medical practitioner who, in his opinion, has special knowledge of the safe use or application of unsealed sources for the purposes of diagnosis;
- (d) to use unsealed sources for any specific medical therapeutic purpose if he is satisfied that the applicant is a nuclear medicine specialist who, in his opinion, has special knowledge of the safe use of unsealed sources for that specific therapeutic purpose;
- (e) to use irradiating apparatus or radioactive materials for medical therapeutic purposes only if he is satisfied that the applicant is a therapeutic radiologist;
- (f) to use irradiating apparatus for dental diagnostic purposes only if he is satisfied that the applicant is a registered dentist who, in his opinion, has special knowledge of the safe use of such irradiating apparatus for the purpose of diagnosis;
- (g) to use irradiating apparatus or radioactive materials for veterinary diagnostic purposes only if he is satisfied that the applicant is a veterinary surgeon or other person who, in his opinion, has special knowledge of the safe use or application of irradiating apparatus or radioactive materials for veterinary purposes;
- (h) to use irradiating apparatus or radioactive materials for industrial, experimental, testing, demonstration, research or other specific purpose only if he is satisfied that the applicant has sufficient knowledge of the safe use of such irradiating apparatus or radioactive materials; or

- (i) to sell or otherwise supply radioactive material which is to be taken internally by or injected into or applied to a human being only if he is satisfied that the applicant is a registered medical practitioner or a registered pharmacist.

(3) Subject to the approval of the Chief Executive —

- (a) each registered medical practitioner may be licensed to use not more than one irradiating apparatus for a specific purpose; and
- (b) each diagnostic radiologist, therapeutic radiologist and nuclear medicine specialist may be granted licences to use irradiating apparatus or unsealed sources for medical diagnostic or medical therapeutic purposes, as the case may be, in clinics situated at not more than 3 different addresses.

(4) No person shall use any radioactive material or irradiating apparatus for any purpose other than that specified in his licence in respect of that material or apparatus.

### **Licence conditions**

7.—(1) In addition to any condition that may be prescribed in respect of licences generally, a licence may be granted subject to such conditions as the Chief Executive sees fit to impose and the conditions so imposed by the Chief Executive may at any time be varied, added to or revoked by the Chief Executive.

(2) Without prejudice to the generality of the powers conferred by paragraph (1), licences may be granted subject to any of the following conditions:

- (a) any licence under section 6 of the Act may be restricted to radioactive materials of a specific kind or may be restricted to specific diagnostic or therapeutic purposes, limited in their type and nature; or
- (b) any licence under section 8 of the Act for the use of irradiating apparatus may be restricted to a specific apparatus or to apparatus of a specific kind, or may be restricted to specific uses limited in their type and nature or may be restricted to their use at a specific place.

(3) Any person who is licensed to sell or otherwise supply radioactive material which is to be taken internally by, injected into or applied to a human being shall do so only —

- (a) where the person is a registered medical practitioner, for the purpose of treatment by him or in accordance with his directions; or
- (b) where the person is a registered pharmacist, under the authority of and in accordance with a prescription signed and dated by a registered medical

practitioner who is similarly licensed, except that no such radioactive material shall be sold, supplied or otherwise dispensed more than once or more than 3 months after the date the prescription was so signed unless the prescription expressly directs that the radioactive material may be dispensed on a specific number of occasions or after specified intervals during a specified period.

### **Cancellation or suspension of licence**

8. The Chief Executive may, in his discretion, cancel or suspend for such period as he thinks fit any licence if the licensee —

- (b) commits an offence under the Act;
- (c) commits a breach of or fails to comply with or observe any of the conditions of the licence; or
- (d) is unable to act owing to illness or otherwise.

### **Renewal of licence**

9.—(1) On application being made to the Chief Executive in the prescribed manner, the Chief Executive may grant to the applicant a renewal of any licence held by the applicant or may, if the Chief Executive thinks fit, refuse to grant a renewal of the licence.

(2) Section 9 of the Act and regulation 7 shall apply to every application for the renewal of a licence as if it were an application for a new licence.

(3) In granting any renewal of a licence, the Chief Executive may endorse the existing licence or he may issue a new licence in lieu thereof, but every such new licence shall show on the face thereof that it is a renewal of the licence.

(4) Every application for the renewal of a licence shall be made not later than one month before the date of expiry of the licence or within such further time as may be allowed by the Chief Executive in any particular case.

(5) The renewal of a licence may be granted in advance and shall, unless previously cancelled, take effect from the expiry date of the licence.

(6) Where an application for renewal of a licence is duly made under this regulation, the licence shall, where the application is not disposed of before the date of expiry of the licence, continue in force until the application is disposed of.

### **Register of licences**



**10.** The Chief Executive shall keep and maintain a register of licences in which shall be entered the names of all persons issued licences under the Act, the premises where the person may carry out the activity authorised by his licence (referred to in these Regulations as the authorised premises) and such other particulars as the Chief Executive may determine.

### **Notification of change of address**

**11.** Every licensee who at any time changes the address of his authorised premises as appearing in the register of licences shall, within 2 weeks thereafter, send to the Chief Executive a notice of his new address and the Chief Executive shall thereupon amend the entry in the register of licences relating to that licensee accordingly.

## **PART IV**

### **GENERAL REQUIREMENTS**

#### **Age requirement**

**12.** No individual below the age of 18 years shall be engaged in radiation work.

#### **Conditions for engaging in radiation work**

**13.—(1)** Every individual engaged in radiation work shall be registered as a radiation worker in accordance with these Regulations unless he is —

- (a) a licensee; or
- (b) a registered or enrolled student of an educational institution who, in the course of his studies, performs any experiment or carries out any research involving the handling or use of irradiating apparatus or radioactive materials under the direct supervision of a licensee authorised to conduct such experiment or research.

(2) An individual shall not be registered as a radiation worker unless he —

- (a) has, within 12 months prior to his application for registration as a radiation worker, undergone a medical examination, which shall include a full blood examination and any other examination as may be required by the Chief Executive, and been certified fit to be engaged in radiation work by an approved registered medical practitioner; and
- (b) has been adequately trained to do such work or fully instructed by an individual licensed to do such work in all the working procedures and rules and the emergency procedures appropriate to his duty and been well

informed of the hazards associated with such work.

(3) Every application for registration or the renewal of any registration as a radiation worker shall be made to the Chief Executive in such form as the Chief Executive may require. A fee of \$105 shall be payable for every such application.

(4) Every individual registered as a radiation worker shall be entitled to receive a certificate of registration and every such certificate of registration shall be valid for such period as shall be stated therein.

(5) Every application for the renewal of registration as a radiation worker shall be made not later than one month before the date of expiry of the current certificate of registration or within such further time as may be allowed by the Chief Executive in any particular case.

(6) The Chief Executive may, if he thinks fit, refuse to register any applicant as a radiation worker or to renew any registration as a radiation worker.

(7) The Chief Executive may, if he thinks fit, cancel the registration of any radiation worker.

(8) Every individual who is working with ionising radiation shall wear a personal monitoring device.

(9) An individual who holds a valid certificate of registration as a radiation worker shall be entitled to personal monitoring service provided by the Chief Executive during the period of validity of his certificate.

## PART V

### CONTROL OF RADIATION EXPOSURE

#### **Restriction of exposure to ionising radiations**

**14.—**(1) No individual who has in his possession or custody or uses any radioactive substances or irradiating apparatus shall cause, permit or suffer any individual to receive a radiation dose greater than can be justified in the circumstances, and in no case a radiation dose in excess of the appropriate annual dose limit specified in the Second Schedule.

(2) Paragraph (1) shall not be construed so as to limit the kind or amount of radioactive substance or ionising radiation which may be intentionally applied to an individual as a necessary part of any diagnostic or therapeutic procedure by or under the direction of a registered medical practitioner or dentist licensed to do so.

(3) Without prejudice to the other requirements of these Regulations, every individual licensed to use any radioactive material or irradiating apparatus shall do all that is reasonably practicable to restrict the extent to which the radiation workers under his supervision are exposed to ionising radiation.

(4) Where a radiation worker has reasonable cause to believe that an occurrence which is liable to result in any individual (other than a radiation worker) receiving a radiation dose in excess of any of the dose limits specified in Part II of the Second Schedule has taken place, he shall report the occurrence to the licensee who shall forthwith conduct an investigation or arrange for an investigation to be conducted.

(5) Where an investigation under paragraph (4) confirms the report of the radiation worker or the licensee has other reason to believe that any individual other than a radiation worker has received a radiation dose in excess of that permitted under Part II of the Second Schedule, the licensee shall forthwith notify the Chief Executive.

### **Arrangements for protection of workers**

**15.**—(1) Every individual licensed to do radiation work shall, as respects himself and all radiation workers under his supervision, make approved arrangements for the monitoring of the individual radiation dose received while performing radiation work.

(2) It shall be the duty of every radiation worker to comply with the approved arrangements referred to in paragraph (1).

(3) A record of radiation dose received by each radiation worker shall be kept by the licensee concerned or his employer and such record shall be kept up to date and shall be open to the inspection of that radiation worker at all reasonable times and for the inspection at all times by the Chief Executive or any person authorised by him. No person shall destroy, damage or mutilate such record except by permission given in writing by the Chief Executive.

(4) Without prejudice to the other requirements of these Regulations, where the Chief Executive has reasonable cause to believe a radiation worker employed may have received, or is likely to receive, in any calendar year, a sum of radiation doses greater than three-tenths of the appropriate dose limit specified in Part I of the Second Schedule, the Chief Executive may serve on the licensee concerned or his employer a written notice requiring him to make approved arrangements as respects all or any of the following matters:

- (a) for the monitoring of any part of the installation, and for the keeping and preserving of records of measurements obtained by such monitoring;
- (b) for the suspension of any radiation worker from work in which he will be

exposed to ionising radiations or for imposing special conditions on his continued employment in any such work; and

(c) for the medical examination of any radiation worker employed.

(5) Without prejudice to the other requirements of these Regulations, where the Chief Executive has reasonable cause to believe that the ingestion of an excessive amount of a radionuclide by any radiation worker has taken place, or could potentially take place, the Chief Executive may serve on the licensee concerned or his employer a written notice requiring him to make approved arrangements as respects all or any of the following matters:

(a) for the monitoring of airborne radionuclides in any part of the installation, and for the keeping and preserving of records of measurements obtained by such monitoring;

(b) for measurements to be made on the amount of radionuclides present in the body of any radiation worker employed, and for the keeping and preserving of the records of such measurements;

(c) for the suspension of any radiation worker from work in which he will be exposed to ionising radiations, or for imposing special conditions on his continued employment in any such work; and

(d) for the medical examination of any radiation worker employed.

## PART VI

### MEDICAL AND RADIOLOGICAL SUPERVISION

#### **Excessive exposure of radiation workers**

**16.**—(1) Whenever any radiation worker has reasonable cause to believe that he or any other radiation worker has received any radiation dose in excess of that permitted under Part I of the Second Schedule, he shall immediately report the circumstances to the licensee, who shall make an immediate investigation.

(2) Where the investigation confirms a report made under paragraph (1) or the licensee has other reason to believe that any radiation worker employed has received a radiation dose in excess of that permitted under Part I of the Second Schedule, the licensee shall forthwith —

(a) suspend the radiation worker from work in which he will be exposed to ionising radiation;

- (b) arrange for a medical examination of the radiation worker to include a full blood examination and any other examination as may be required by the Chief Executive;
- (c) notify the Chief Executive; and
- (d) keep a record of the circumstances as respects the radiation worker.

(3) Whenever it appears from the radiation dose record that any radiation worker has received a radiation dose in excess of that permitted under Part I of the Second Schedule, the licensee shall forthwith —

- (a) suspend the radiation worker from work in which he will be exposed to ionising radiation;
- (b) make an investigation or arrange for an investigation to be made;
- (c) notify the Chief Executive; and
- (d) arrange for a medical examination of the radiation worker which shall include a full blood examination and any specific examination as may be required by the Chief Executive.

### **Transfer record**

17.—(1) Where any individual ceases to be employed as a radiation worker, his employer shall forthwith prepare a transfer record in an approved form and containing the approved particulars. The employer, if he knows the whereabouts of that individual, shall forthwith supply him with the transfer record and shall in any case forthwith send a copy of it to the Chief Executive.

(2) Before any individual who was previously employed as a radiation worker by another employer is employed, or engaged for employment, as a radiation worker, that individual shall notify his employer or, as the case may be, prospective employer, of his previous employment and shall, if he has received from his previous employer in a transfer record and that record is still in his possession, produce it to his employer or prospective employer, as the case may be. In the event of that individual being employed, or engaged for employment, as a radiation worker the transfer record shall be handed to and retained by the employer.

(3) When the employer is aware that any individual employed, or engaged for employment, as a radiation worker was previously employed by another employer to do radiation work and that individual does not produce a transfer record in pursuance of paragraph (2), the employer shall forthwith apply to the Chief Executive for a copy of the record.

## **Periodic medical examination of radiation workers**

**18.** The employer shall arrange for medical examinations once every year by an approved registered medical practitioner (which include a full blood examination and any other examination as may be required by the Chief Executive) of every radiation worker who is engaged in work which is liable to result in the receiving by the worker of a sum of radiation doses which is greater than three-tenths of the appropriate dose limit permitted under Part I of the Second Schedule in any calendar year.

## **PART VII**

### **LABELLING OF IRRADIATING APPARATUS AND RADIOACTIVE MATERIALS**

#### **Labelling of irradiating apparatus**

**19.—**(1) Except as provided in paragraph (2), every licensee and every person who possesses or has under his control any irradiating apparatus shall —

- (a) to each such irradiating apparatus possessed by him or under his control, other than an irradiating apparatus containing a radioactive substance, securely attach and keep attached in a label containing the standard radiation hazard symbol specified in the Fourth Schedule together with the words “DANGER — RADIATION. This apparatus produces radiation when energised” immediately adjacent to the symbol; and
- (b) to each such irradiating apparatus possessed by him or under his control that contains a radioactive substance, securely attach and keep attached a label containing —
  - (i) the standard radiation hazard symbol specified in the Fourth Schedule together with the words “DANGER — RADIOACTIVE” immediately adjacent to the symbol; and
  - (ii) the kind and activity of the radioactive substance in the irradiating apparatus and the date of measurement of such activity.

(2) The words “DANGER — RADIATION. This apparatus produces radiation when energised” and “DANGER RADIOACTIVE” appearing in the labels specified in paragraph (1) may be omitted for apparatus used for medical or dental purposes if access to the area where the irradiating apparatus is located is strictly controlled.

#### **Labelling of radioactive materials**

**20.** Every licensee and every individual who possesses or has under his control any radioactive material shall —

- (a) to each container of each such radioactive material possessed by him or under his control securely attach and keep attached a label containing the standard radiation hazard symbol specified in the Fourth Schedule together with the words “DANGER — RADIOACTIVE” immediately adjacent to the symbol; and
- (b) to each container used by him to store such radioactive material securely attach or keep attached a label showing clearly the kind and activity of the radioactive material and the date of measurement of such activity in addition to the label required by paragraph (a).

### **Labelling of radiation areas**

**21.**—(1) Except as provided in paragraph (2), every licensee, every individual who possesses or has under his control any radioactive material or any irradiating apparatus, and every individual in charge of any place where a radiation hazard may exist, shall, in addition to any other labels required by these Regulations, display a notice containing the standard radiation hazard symbol specified in the Fourth Schedule —

- (a) near to each place where any radioactive material or any irradiating apparatus is used;
- (b) at each entrance to any place where any radioactive material is used or stored; and
- (c) at each entrance to any place where any irradiating apparatus is used.

(2) Paragraph (1) shall not apply to a sealed source which gives a radiation level not exceeding 0.1  $\mu$ Sv per hour at one metre away from the centre of the source.

(3) Any premises where the total amount of radioactive materials kept or stored therein exceeds 35 GBq shall have a notice stating that radioactive materials are kept or stored on the premises and the notice shall be displayed at all main entrances to the premises in such a manner that it can be clearly seen by any individual entering the premises.

### **Requirements for labels**

**22.** Each label and notice required to be used or displayed by these Regulations shall be as large as practicable in each particular circumstance.

### **Conditions for using and removal of labels**

23.—(1) No person shall use any label or notice described in these Regulations except for the purposes of these Regulations or to denote a radiation hazard.

(2) When any radiation hazard ceases to exist all labels and notices used or displayed in connection with such hazard shall be immediately removed by the person who was required by regulation 21 to use or display the same.

## PART VIII

### STORAGE OF RADIOACTIVE MATERIALS

#### Conditions for safe storage and keeping of radioactive materials

24.—(1) Radioactive materials shall be stored or kept in such a manner as —

- (a) to prevent any individual not being authorised by the licensee from having access to them;
- (b) not to create outside the defined area where the radioactive materials are stored or kept at any location accessible to any individual other than a radiation worker a radiation level exceeding 0.5  $\mu\text{Sv}$  per hour; and
- (c) not to suffer any individual other than a radiation worker to receive a radiation dose in excess of 20  $\mu\text{Sv}$  in a period of any 7 consecutive days.

(2) A vault or room wherein any radioactive material is stored, kept, used or handled and from which any radionuclide in gaseous, vapour or aerosol form is or may be emitted shall be suitably ventilated in such a manner that the radionuclide does not constitute a radiation hazard and will not be present at any time in or about such vault or room in a concentration such that inhalation or ingestion by an individual exceeds one-twentieth of the ALI specified for that radionuclide in the Third Schedule.

(3) When radioactive materials are stored temporarily, or when not being used are kept, in a workroom, laboratory or any other place where any individual is regularly or frequently present, these radioactive materials shall be enclosed in adequate containers or otherwise shielded so that —

- (a) the average radiation level at 5 cm from the surface of each container or shield does not exceed 40  $\mu\text{Sv}$  per hour and the maximum radiation level does not exceed 200  $\mu\text{Sv}$  per hour; and
- (b) the average radiation level at one metre from the centre of each source does not exceed 4  $\mu\text{Sv}$  per hour and the maximum radiation level does not exceed 20  $\mu\text{Sv}$  per hour.



## **Precautions for safe storage and keeping of radioactive materials**

**25.**—(1) Where there is any possibility that any chemical, radiation, or other action might weaken or rupture the container of a radioactive material sufficiently to cause leakage from the container, the container shall be provided with a suitable secondary tray, or catchment, adequate to retain the entire amount of such radioactive material in that container.

(2) Storage containers for radioactive materials in excess of 35 GBq shall be designed to be —

- (a) resistant to fire and any severe shock or stress;
- (b) able to withstand any temperature that may be reasonably anticipated; and
- (c) structurally sound having regard to corrosion, radiation, temperature effects and chemical or other action that may develop over the period of intended storage or use.

(3) Suitable provisions shall be made to minimise the radiation hazard to any individual who may be doing emergency work in or about the place where the radioactive material is stored or kept in the event of fire, flood or any other catastrophe or emergency.

## **PART IX**

### **ACCOUNTING AND INTERNAL TRANSPORT OF RADIOACTIVE MATERIALS AND CHECKING OF LEAKAGE OR BREAKAGE OF SEALED SOURCES**

#### **Accounting for radioactive materials**

**26.**—(1) Subject to paragraph (2), any person who has in his possession any radioactive material shall keep, or cause to be kept, a book containing a record of the following particulars in respect of the radioactive material:

- (a) the date of receipt;
- (b) the nature and form of the radioactive material at the date referred to in sub-paragraph (a);
- (c) the activity of the radioactive material at the date specified by the manufacturer;
- (d) the whereabouts of the radioactive material kept up to date on each working day;

- (e) where the radioactive material is a sealed source —
  - (i) the distinguishing number or other identifying mark; and
  - (ii) the date and the manner of disposal of the sealed source; and
- (f) where the radioactive material is an unsealed source —
  - (i) the quantity used each time and the date and purpose of use; and
  - (ii) the date and the manner of disposal of the radioactive material or any portion of it.

(2) Nothing in this regulation shall apply to radioactive materials —

- (a) in the course of their manufacture; or
- (b) while stored, without having been used, on the premises in which they were manufactured or in which their manufacture was completed.

(3) If any radiation worker employed by a person licensed to have in his possession radioactive material has reasonable grounds for believing that any radioactive material has been lost or mislaid, it shall be the duty of that radiation worker to notify the person licensed of the loss of or missing radioactive materials immediately.

(4) The licensee shall take immediate steps with a view to finding the radioactive material and if the radioactive material is not accounted for within 24 hours, he shall forthwith notify the Chief Executive.

### **Internal transport of sealed sources**

**27.** No sealed source shall be transported within the premises under the control of a licensee unless it is transported —

- (a) in a suitable container or by other appropriate methods so that the same requirements for radiation level as prescribed in regulation 24(3) are met except where the Chief Executive directs otherwise;
- (b) by or under the immediate supervision of the licensee or a radiation worker authorised by him; and
- (c) in such a way that the individual receiving it is made aware that what he is receiving is a sealed source.

### **Internal transport of unsealed sources**

**28.** No unsealed source shall be transported within the premises under the control of a

licensee unless it is —

- (a) enclosed within a suitable container adequately shielded so that the same requirements for radiation level as prescribed in regulation 24(3) are met except where the Chief Executive directs otherwise;
- (b) transported by or under the immediate supervision of the licensee or a radiation worker authorised by him; and
- (c) transported with a tag attached to each container giving the following information:
  - (i) name of isotope;
  - (ii) nature, physical and chemical form;
  - (iii) activity with date.

### **Checking of leakage or breakage of sealed source**

**29.**—(1) Every person who possesses or has under his control any sealed source shall, except where the Chief Executive directs otherwise —

- (a) ensure that a wipe test for leakage of radioactive substance is made by a qualified individual at least in every period of 12 months of —
  - (i) the bonding of a sealed source which does not have an immediate container; and
  - (ii) every container in which such a sealed source is permanently installed but which does not form part of the sealed source;
- (b) maintain a register containing the required particulars of every wipe test carried out in pursuance of sub-paragraph (a); and
- (c) inform the Chief Executive immediately if the result of any wipe test carried out in pursuance of sub-paragraph (a) is positive.

(2) Where any radioactive substance is leaking, or is likely to leak, from the immediate container or the bonding which forms part of a sealed source or in the event of the immediate container or the bonding which forms part of a sealed source being broken —

- (a) the Chief Executive shall be informed immediately;
- (b) all practicable measures shall be taken forthwith to safeguard every individual present in the vicinity of the sealed source, including, where

necessary, the immediate vacation of all appropriate areas;

- (c) the immediate container or bonding shall be placed in a leak-proof container forthwith and shall not be brought into use until all necessary repairs have been effected; and
- (d) effective steps to decontaminate areas affected by the radioactive substance shall be taken as soon as practicable by or under the supervision of the licensee or any individual approved by the Chief Executive as qualified to do so and any individual taking part in such work shall be properly equipped for the purpose.

(3) The Chief Executive may require a source to be subject to any additional leakage test as he may specify.

## PART X

### USE OF SEALED SOURCES AND IRRADIATING APPARATUS IN INDUSTRIAL RADIOGRAPHY AND SOME OTHER PROCESSES

#### **Application of this Part**

**30.** This Part shall apply to the following processes:

- (a) the use of ionising radiation in industrial radiography or industrial fluoroscopy;
- (b) the testing of irradiating apparatus intended to produce ionising radiation, not being irradiating apparatus to which Parts XI, XII and XIV apply; and
- (c) the use of ionising radiations in the irradiation of materials for the purpose of inducing chemical, physical or biological changes, including the irradiation of materials for the purpose of sterilisation, disinfection or disinfestation or for the purpose of preserving food, but not including changes induced solely for the purpose of measuring ionising radiations.

#### **Requirements for a walled enclosure or cabinet**

**31.—**(1) Where practicable, a walled enclosure or a cabinet shall be set apart for the purpose of carrying out any process to which this Part applies, and such a walled enclosure or cabinet shall comply with the following requirements:

- (a) the walled enclosure or cabinet shall be so constructed as to provide adequate shielding to personnel in the adjacent area and no individual other

than a radiation worker present in the area adjacent to the walled enclosure or cabinet shall receive a radiation dose in excess of —

- (i) 1.5  $\mu\text{Sv}$  in any one hour; or
  - (ii) 20  $\mu\text{Sv}$  in a period of any 7 consecutive days;
- (b) the radiation level anywhere outside the walled enclosure or cabinet without restricted access while any irradiating apparatus is energised or any sealed source is exposed in the walled enclosure or cabinet shall not exceed 10  $\mu\text{Sv}$  per hour;
- (c) except where other appropriate safety arrangements have been approved by the Chief Executive, effective devices shall be provided and maintained —
- (i) to ensure that if any door or part of the walled enclosure or of the cabinet is opened no irradiating apparatus therein can be energised and that if any door or part of the walled enclosure or of the cabinet is opened while any irradiating apparatus therein is energised the irradiating apparatus is automatically de-energised and can only be re-energised at the control panel; and
  - (ii) where the walled enclosure or the cabinet is an enclosure or cabinet to which no individual is authorised to have access while a sealed source contained therein is exposed and the exposure of the sealed source is electrically or pneumatically controlled, to ensure that no door or part of the enclosure or of the cabinet can be opened while the sealed source is exposed and that the sealed source cannot be exposed while any such door or part is open;
- (d) where the exposure of a sealed source used in the walled enclosure or cabinet is controlled manually, any door or part of the walled enclosure or of the cabinet shall be locked when left unattended;
- (e) a radiation monitor shall be readily available so that any individual entering the walled enclosure or cabinet can check the radiation dose rate if he is in any doubt whether the source is in the shielded position; and
- (f) the control panel for any irradiating apparatus therein which is intended to produce ionising radiations shall be situated outside the walled enclosure or cabinet.

(2) Where necessary for the protection of any individual who may be accidentally shut inside a walled enclosure or a cabinet, there shall be provided and properly maintained one or more of the following:

- (a) means of exit so constructed that such an individual can leave the enclosure or cabinet without delay;
- (b) means whereby such an individual can quickly control all the sources of ionising radiations within the enclosure or cabinet; and
- (c) shielding for such an individual within the enclosure or cabinet appropriate to the circumstances.

(3) Where necessary, suitable means of communication shall be provided and maintained to enable any individual shut inside a walled enclosure or a cabinet to summon help from outside the enclosure or cabinet.

### **Requirements for field site**

**32.**—(1) Where it is necessary for any process to which this Part applies to be carried out in a field site, a boundary of the field site shall be set up and clearly defined by some appropriate means, such as ropes, rails, fences, walls of a building or notices, such that the radiation level outside the boundary shall not exceed 25  $\mu$ Sv per hour.

(2) A boundary of the field site referred to in paragraph (1) need not afford any control over access to the site, but such control shall be affected by continuous and competent supervision of the site whenever a sealed source is exposed or an irradiating apparatus is energised within the site.

(3) The boundary of the field site shall be adequately posted with clearly legible warning notices incorporating the words “DANGER — RADIATION” and the standard radiation hazard symbol specified in the Fourth Schedule.

(4) The radiation worker in charge at the field site shall ensure that all the requirements for a field site are met before the process is carried out.

(5) Every sealed source and irradiating apparatus shall be locked in the OFF condition whenever it is not in use and all necessary precautions shall be taken to ensure that no unauthorised removal of a sealed source can occur.

(6) A radiation area monitor shall be readily available and used at the field site to check that a source has returned to the OFF condition immediately on completion of each exposure and to check that the radiation level boundary requirement specified in paragraph (1) is met.

### **Warning signals**

**33.** Adequate warning to every individual in the vicinity and any individual who may be inside the walled enclosure, cabinet or boundary of a field site shall be given by

appropriate light or audible signals or both —

- (a) when a sealed source is about to be exposed or when an irradiating apparatus is about to be energised; and
- (b) while a sealed source is exposed or an irradiating apparatus is energised and the signals given for the purposes of paragraph (a) shall be distinguishable from those given for the purposes of this paragraph.

## PART XI

### USE OF IRRADIATING APPARATUS FOR MEDICAL, DENTAL AND VETERINARY DIAGNOSTIC PURPOSES

#### Requirements for X-ray diagnostic installations

- 34.** Every X-ray diagnostic installation shall comply with the following requirements:
- (a) the X-ray room shall have sufficient space to provide safe accommodation for every individual who is in the room;
  - (b) the walls and doors of the X-ray room shall have adequate thickness or shall be adequately lead-lined to provide protection against the primary beam and the secondary radiation for any individual in rooms adjacent to the X-ray room and, except in exceptional circumstances where the Chief Executive directs otherwise, that nowhere outside the X-ray room accessible to any individual shall have a radiation level exceeding 10  $\mu$ Sv per hour while the X-ray machine is being operated at its maximum rated current for the maximum rated voltage and at its normal operation positions;
  - (c) the radiation dose rate due to leakage radiation through the X-ray tube housing when the tube is operating at its maximum operating conditions shall, except where the Chief Executive directs otherwise, not exceed in any direction, 1 mSv per hour at a distance of one metre from the focus of the X-ray tube;
  - (d) in the case of diagnostic tubes operating above 150 kVp, the control panel shall be located in a separate room and in the case of diagnostic tubes operating at 150 kVp or below but above 75 kVp, the control panel shall be located either in a separate room or operated by an individual behind a protective screen or shielding as far from the tube as is conveniently possible and in the case of diagnostic tubes operating at 75 kVp or below, the position of the operator controlling the time switch shall, when no protective shield is used, be away from the path of the primary beam and

- not less than 2 metres from the tube;
- (e) installations in which fluoroscopic or other examinations requiring the proximity of concerned personnel to the primary beam are conducted shall be sufficiently equipped with appropriate protective clothing such as lead gloves, lead aprons and mobile lead screens;
  - (f) the X-ray room shall be provided with a suitable warning signal, such as a red light, at a conspicuous place outside the room. Such a signal shall, whenever the X-ray machine is being used, be switched on to deter the entry of any individual not connected with the particular X-ray examination; and
  - (g) when more than one tube can be operated from a single control panel, there shall be some clear indication on the control panel to show which tube is connected for use.

### **Protection of patients and personnel**

**35.**—(1) No individual unless specifically concerned with a particular X-ray examination shall be in the X-ray room while the tube is energised for the said examination.

(2) The field size shall be limited to the minimum and, unless inappropriate for the technique employed, fast films and intensifying screens shall be used such that the irradiation of the patient during X-ray examination is no greater than is necessary to produce a satisfactory diagnostic result.

(3) The total tube filtration, inherent plus added, for normal diagnostic work shall be equivalent to not less than the following:

- (a) 1.5 mm of aluminium at voltages up to and including 70 kVp;
- (b) 2.0 mm of aluminium at voltages above 70 kVp and up to and including 100 kVp; and
- (c) 2.5 mm of aluminium at voltages above 100 kVp.

(4) If it is necessary to perform an X-ray examination on a woman known to be pregnant, precautions shall be taken to minimise the irradiation of the foetus including the provision of protective clothing where practicable.

(5) No radiation worker, woman known to be pregnant or any individual below 18 years of age shall assist in —

- (a) supporting a child or weak patient; or



(b) holding a dental film for a patient,

while the child or the patient is undergoing radiographic or fluoroscopic examination. As far as is practicable mechanical devices shall be used for such purposes, otherwise an individual who is neither a radiation worker nor a woman known to be pregnant and above 18 years of age may be asked to render such assistance. Any individual rendering such assistance shall be provided with protective clothing and as far as possible be so positioned as to avoid the primary beam.

(6) An animal shall not be held by any individual for radiographic or fluoroscopic examination unless other means of immobilisation such as tranquillisation, anaesthesia or restraint by mechanical means are impracticable. When manual restraint is necessary, the following requirements shall be complied with:

- (a) the animal shall be held by the minimum number of individuals required;
- (b) no woman known to be pregnant, no individual below 18 years of age, and, except as provided in sub-paragraph (c), no individual who is a radiation worker and no individual who is a member of the staff of the veterinary establishment shall assist in restraining the animal;
- (c) in exceptional cases where it is necessary for the animal to be held by members of the staff of the veterinary establishment, only those who are registered radiation workers and trained for such purposes shall be so employed; and
- (d) any individual rendering assistance to restrain the animal shall be provided with protective clothing and as far as possible be so positioned as to avoid the primary beam.

(7) No intra-oral fluoroscopy shall be done and no fluoroscopy work shall be done with mobile units unless the units are properly designed for fluoroscopy with image intensification.

(8) The whole of a fluoroscopic useful beam shall be intercepted by a barrier having a lead equivalent of not less than the following:

- (a) 1.5 mm for apparatus having a maximum operating potential up to and including 70 kVp;
- (b) 2.0 mm for apparatus having a maximum operating potential above 70 kVp and up to and including 100 kVp; and
- (c) 2.0 mm plus an additional 0.01 mm for each kVp the maximum operating potential exceeds 100 kVp.

(9) Protective clothing shall be examined visually at frequent intervals and shall be examined radiographically at least annually to ensure that the protection afforded has not been impaired as a result of cracks in the material. A record of such examinations shall be kept.

## PART XII

### USE OF IRRADIATING APPARATUS FOR MEDICAL THERAPEUTIC PURPOSES

#### **Requirements for X-ray therapeutic installations**

**36.** Every X-ray therapeutic installation shall comply with the following requirements:

- (a) the X-ray room shall have sufficient space to provide safe accommodation for every individual who is in the room;
- (b) the walls and doors of the X-ray room shall have adequate thickness or shall be adequately lead-lined to provide protection against the primary beam and the secondary radiation for any individual in rooms or wards adjacent to the X-ray room and nowhere outside the X-ray room accessible to any individual shall have a radiation level exceeding 10  $\mu\text{Sv}$  per hour while the X-ray unit is being operated at its maximum rated kilovoltage and current and at its normal operation positions. No individual other than a radiation worker who is present for any reason in a room, ward or any area adjacent to the X-ray room shall receive a radiation dose from the X-ray room in excess of —
  - (i) 1.5  $\mu\text{Sv}$  in any one hour; or
  - (ii) 20  $\mu\text{Sv}$  in a period of any 7 consecutive days;
- (c) except as provided by paragraph (i), the control panel shall be located outside the X-ray room;
- (d) the room housing the X-ray unit shall be provided with a suitable warning signal, such as a red light, both at a conspicuous place inside the room and at a conspicuous place outside the room. Such a warning signal shall, whenever the X-ray unit is being used, be automatically switched on to warn any individual who is in the room or intending to enter the room;
- (e) means shall be provided for observing the patient during treatment and for communication between the patient in the treatment room and the operator in the control room;

- (f) the X-ray unit shall be provided with a device which automatically terminates the treatment after a preset time or radiation dose. Such a device shall not be solely relied upon for the termination of the treatment;
- (g) the door to the treatment room shall be provided with an interlocking device which will ensure that —
  - (i) the beam can be switched on only when the door is completely closed; and
  - (ii) if the door is accidentally opened after the X-ray unit has been energised, the beam will be automatically switched off and can only be switched on again at the control panel;
- (h) the radiation dose rate due to leakage radiation through the X-ray tube housing shall not exceed, in any direction, 10 mSv per hour at one metre when the tube is operating at its maximum operating conditions with the shutter fully closed; and
- (i) in the case of units of maximum rated kilovoltage 100 kVp or below or units only operated at 100 kVp or below the control panel may be located in the treatment room provided adequate protection for the operator is afforded by means of a screen or screens.

### **Requirements for therapeutic installations using irradiating apparatus other than X-ray units**

**37.** Every therapeutic installation using teletherapy irradiating apparatus including charged particle accelerators, neutron generators and those apparatus containing sealed sources but excluding X-ray units shall comply with the following requirements:

- (a) the requirements for X-ray therapeutic installations as specified in regulation 36(a) to (f) shall be met;
- (b) the door to the treatment room shall be provided with an interlocking device which will ensure that —
  - (i) in the case of an irradiating apparatus not containing a sealed source, the radiation beam can be switched on only when the door is completely closed and that the radiation beam will be automatically switched off if the door is accidentally opened after the apparatus has been energised and the irradiating apparatus can only be re-energised at the control panel; and
  - (ii) in the case of an irradiating apparatus containing a sealed source,

the sealed source can be exposed only when the door is completely closed and that the sealed source will be immediately shielded or returned to the shielded store if the door is accidentally opened after the sealed source has been exposed; and

- (c) in the case where an irradiating apparatus contains a sealed source, the apparatus shall be so designed to have the sealed source automatically shielded or returned to the shielded store in the event of a power failure.

### **Protection of patients and personnel**

**38.**—(1) Except as provided in paragraph (2), no individual except the patient shall remain in the treatment room during treatment.

(2) For treatment using X-ray apparatus operated below 100 kVp, the operator shall be allowed to remain in the treatment room provided adequate protection is afforded by means of a screen or screens.

(3) In the case where an ionisation chamber is not built into the aperture of the X-ray tube to indicate the dose output of a unit, the dose output of such unit shall be measured periodically for various commonly employed parameters such as kilovoltage, tube current, filter, field size and focus-skin distance and a record shall be kept of such measurements.

## **PART XIII**

### **USE OF SEALED SOURCES FOR MEDICAL PURPOSES**

#### **Requirements as to sealed sources for medical purposes**

**39.**—(1) Every hospital or medical institution in which sealed sources are used for therapy or any other medical purpose shall be equipped with radiation monitors or survey meters suitable for checking contamination and measuring low level beta-radiation and gamma-radiation.

(2) If any sealed source is found leaking, it shall be sealed immediately in a leak-proof container and the individual in charge of the sealed source shall immediately be informed.

(3) Properly equipped areas shall be provided for preparing, sterilizing and cleaning sealed radioactive sources, such as those used for brachytherapy or ophthalmic purposes. These areas shall be well ventilated and well illuminated.

- (4) Hospitalised patients undergoing treatment with any sealed source shall —
- (a) be accommodated in rooms being used solely for patients undergoing such treatment and admittance to these rooms shall be strictly controlled;
  - (b) have attached to their beds a notice containing any necessary nursing precautions, the standard radiation hazard symbol specified in the Fourth Schedule and, where the radiation level at one metre from a patient exceeds 20  $\mu\text{Sv}$  per hour, a warning that an external radiation hazard exists; and
  - (c) not leave the ward or treatment room without the approval of the radiologist in charge of the treatment.

(5) Any temporary implant of a sealed source, including a nuclear battery used to power a cardiac pacemaker, shall be removed from a corpse before such corpse is disposed of.

(6) No post mortem examination, cremation or embalming process shall be carried out on a corpse known to contain a sealed source without the prior approval in writing of the Chief Executive or of the Medical Director of the hospital responsible for the implanting of the sealed source.

## PART XIV

### USE OF SEALED SOURCES AND IRRADIATING APPARATUS IN TEACHING, RESEARCH AND SOME INDUSTRIAL PROCESSES

#### **Requirements as to charged particle accelerators**

**40.**—(1) This regulation shall apply to charged particle accelerators such as Van de Graaff accelerators, electrostatic generators, neutron generators, linear accelerators, cyclotrons, betatrons, synchro-cyclotrons, synchrotrons and proton synchrotrons.

(2) Every accelerator to which this regulation applies shall be adequately shielded so that —

- (a) the radiation level anywhere outside the enclosure in which the accelerator is installed, being an area accessible to any individual while the accelerator is energised shall not exceed 10  $\mu\text{Sv}$  per hour;
- (b) no individual other than a radiation worker shall receive a radiation dose from the accelerator in excess of —
  - (i) 1.5  $\mu\text{Sv}$  in any one hour; or

(ii) 20  $\mu\text{Sv}$  in a period of any 7 consecutive days; and

(c) no individual shall receive a radiation dose at a rate exceeding 10  $\mu\text{Sv}$  per hour at any time while operating or using the accelerator.

(3) Effective interlocks shall be provided so that the charged particle accelerator has to be switched off before any door of the enclosure in which the charged particle accelerator is installed is opened and cannot be switched on so long as the door is open.

(4) Adequate warning to every individual in the vicinity shall be given by appropriate light or audible signals or both while the accelerator is energised.

(5) The warning signals shall be arranged to operate automatically.

### **Requirements as to X-ray analytical apparatus**

41.—(1) This regulation shall apply to X-ray analytical apparatus.

(2) Any apparatus to which this regulation applies shall be adequately shielded.

(3) Effective arrangements shall be provided, maintained and used to prevent insertion of any part of the body into a useful beam.

(4) Where an X-ray diffraction camera or slit collimating system is in use, the useful beam passing between the X-ray tube aperture and the camera or collimating system shall be completely enclosed so as to provide adequate shielding.

(5) Adequate warning to every individual in the vicinity shall be given by appropriate light or audible signals or both while the X-ray tube or apparatus to which this regulation applies is energised.

(6) The warning signals shall be arranged to operate automatically.

### **Requirements as to sealed sources used in gauges, etc.**

42.—(1) This regulation shall apply to sealed sources used in thickness gauges, density gauges, package monitors, level gauges, static eliminators, analysers or other analytical, inspection or gauging equipment.

(2) The sealed source shall be provided with an adequate and efficient cover plate, shutter or shield which —

(a) shall be capable of being easily, securely and quickly placed or moved so as to attenuate the useful beam as far as is reasonably practicable; and

(b) shall be used whenever practicable to attenuate the useful beam and

whenever reasonably practicable shall be arranged to operate automatically,

and a means shall be provided to indicate clearly whether or not the said cover plate, shutter or shield is in the closed position.

(3) The housing of each sealed source shall be legibly engraved, stamped or otherwise permanently marked to give a warning that it contains radioactive material.

(4) Adequate shielding shall be provided for the sealed source or other measures taken to ensure that regulation 24 is complied with.

### **Requirements as to irradiating apparatus used in gauges, monitors, etc.**

**43.**—(1) This regulation shall apply to apparatus designed to produce ionising radiations (other than irradiating apparatus to which Part X, XI or XII, or regulation 40 or 41 applies) used in thickness gauges, density gauges, package monitors, level gauges, analysers or other analytical, inspection or gauging equipment.

(2) The irradiating apparatus shall be adequately shielded.

(3) Adequate warning to every individual in the vicinity shall be given by appropriate light or audible signals or by both, arranged to operate automatically —

(a) when a machine or apparatus is about to be energised;

(b) while a machine or apparatus is energised;

(c) when any shutter used for the purpose of attenuating the useful beam is about to be opened; and

(d) while any shutter used for the purpose of attenuating the useful beam is open, and the signals given for the purposes of sub-paragraphs (a) to (d) shall be distinguishable from each other.

(4) Effective arrangement shall be provided, maintained and used to prevent insertion of any part of the body into a useful beam.

## **PART XV**

### **USE OF UNSEALED SOURCES IN MEDICAL, INDUSTRIAL AND RESEARCH INSTALLATIONS AND IN EDUCATIONAL INSTITUTIONS**

#### **General facilities required**

**44.**—(1) All installations and institutions where unsealed radioactive substances are

used or handled shall have adequate facilities where appropriate for radioisotope storage, preparation, administration, monitoring and counting.

(2) Working areas shall be provided with disposable paper towels and paper handkerchiefs or the equivalent and foot operated waste bins. These bins shall be lined with removable polythene bags to facilitate the removal of the waste and to prevent the spread of contamination.

(3) All work surfaces shall be of a non-porous and non-reactive material such as stainless steel and shall be covered with polythene sheets.

(4) A glove box or fume cupboard shall be provided for dry and dusty operations involving unsealed sources.

(5) All radioisotope laboratories or workrooms shall be adequately ventilated and shall be provided with washing facilities suitable for decontamination purposes.

### **Handling of unsealed sources**

**45.**—(1) No individual shall eat, drink, smoke or apply cosmetics inside a radioisotope laboratory or workroom or in any working area where an unsealed source is or may be used, handled or kept and every individual shall thoroughly wash his hands before leaving such a laboratory, workroom or working area.

(2) In a radioisotope laboratory or workroom or working area where an unsealed source is or may be used, handled or kept, all personnel shall wear protective clothing such as laboratory or surgical coats and the protective clothing shall not be used outside the laboratory, workroom or working area and for this purpose the protective clothing shall be identifiable.

(3) Any working area used for work involving the use or handling of an unsealed source shall, immediately after such work, be checked for radioactive contamination and be decontaminated if any contamination is found.

(4) Manipulations involving unsealed sources shall be performed with adequate shielding and carried out over a suitable drip tray or with some other form of secondary container which will minimise the effects of breakages or spillages.

(5) Where practicable, all operations likely to produce radioactive contamination of the air through the production of aerosols, smoke or vapours shall be done in a glove box or in a fume cupboard; otherwise, any individual performing such an operation shall be adequately equipped with a personal respiratory protection system.

(6) Where appropriate, surgical or disposable polythene gloves shall be worn during work with radioactive materials and such gloves shall be washed and checked for contamination after use; and in the event of persistent contamination, the gloves shall be



discarded and treated as radioactive waste.

(7) Items such as glassware, tools and cleaning equipment meant for use with unsealed sources shall be identifiable and shall be used exclusively for this purpose.

(8) Pipetting or glass-blowing by mouth shall not be done in a radioisotope laboratory or workroom and, unless it is done in specially ventilated facilities, glass-blowing, welding, brazing or soldering shall not be performed on contaminated equipment.

## **Monitoring**

**46.**—(1) Contamination levels in working areas where unsealed radioactive sources are handled shall be regularly monitored by using an appropriate contamination monitor. A record of the results of such monitoring shall be kept and the contamination monitor used for such monitoring shall be calibrated and checked regularly.

(2) All protective clothing such as laboratory or surgical coats shall be checked for contamination periodically.

(3) Contamination of working surfaces, clothing, skin, hands and equipment by radioactive materials shall be checked immediately after any manipulation, or sequence of manipulations, involving an unsealed source and precautions shall be taken to prevent the spread of any such contamination.

(4) Filters of glove boxes and fume cupboards shall be monitored and checked periodically, and if any such filter is found heavily contaminated or damaged, it shall be discarded and treated as radioactive waste.

## **Control of radioactive contamination**

**47.**—(1) Instructions and facilities for normal decontamination shall be available in the working area and all radiation workers shall be conversant with the relevant procedures.

(2) When an individual or his clothing becomes contaminated by a radionuclide to a degree in excess of the limit specified in the Fifth Schedule or, where there is more than one radionuclide, in excess of the lowest limit specified for the radionuclides in the Fifth Schedule, he shall remove such contamination or the contaminated clothing before leaving the work area.

(3) Clothing or other material having been contaminated by a radionuclide to a degree in excess of the limit specified in the Fifth Schedule or, where there is more than one radionuclide, in excess of the lowest limit specified for the radionuclides in the Fifth Schedule —

- (a) shall not be removed from the work area or left or deposited with a public laundry or dry-cleaner;
- (b) shall be placed in a plastic bag and adequately shielded and shall not be used again until it has been properly decontaminated; and
- (c) if the degree of contamination cannot be lowered by any means, shall —
  - (i) be stored up to allow the contaminant to decay if its half-life is short; or
  - (ii) be discarded and treated as radioactive waste.

(4) When any working area becomes contaminated by a radionuclide to a degree in excess of the limit specified in the Fifth Schedule or, where there is more than one radionuclide, in excess of the lowest limit specified for the radionuclide in the Fifth Schedule, appropriate steps shall be carried out immediately to decontaminate such area and no individual except those who carry out the decontamination work shall be allowed to enter or to work in such area until the decontamination work has been completed.

#### **Additional requirements for medical use of unsealed sources**

**48.**—(1) Admittance to rooms being used to accommodate patients undergoing treatment with unsealed sources shall be strictly controlled and these rooms shall —

- (a) not be used to accommodate patients not undergoing treatment with unsealed sources; and
- (b) be provided with a toilet and bathroom for the exclusive use of such patients.

(2) Patients undergoing treatment with unsealed sources shall not leave the treatment room or ward without the approval of the radiologist in charge of the treatment.

(3) No post mortem examination, cremation or embalming process shall be carried out on a corpse known to contain radioactive material without the prior approval in writing of the Chief Executive or the Medical Director of the hospital responsible for the administration of such radioactive material.

## **PART XVI**

### **RADIATION ACCIDENTS DEFINITION OF RADIATION ACCIDENT**

## Definition of radiation accident

49.—(1) For the purposes of this Part, a radiation accident shall be considered to have occurred in a non-medical application of ionising radiation or radioactive material if —

- (a) an unplanned or unexpected uncontrolled high level of ionising radiation occurs as in the case of loss, by damage of the radiation shielding, of a sealed radioactive source or of irradiating apparatus;
- (b) an individual enters a high radiation field by accident;
- (c) there is loss of control of unsealed radioactive material causing a spillage or leakage of the radioactive material;
- (d) the skin or clothing of an individual becomes contaminated; or
- (e) radioactive material is accidentally released into the environment in excess of the discharge level permitted by the Chief Executive,

such that —

- (i) any individual has, or could have, received an effective or committed an effective dose which is equal to or in excess of one fifth of the appropriate dose limit specified in the Second Schedule;
- (ii) the skin or personal clothing of any radiation worker is contaminated in excess of 50 times the appropriate permitted contamination limits for skin or personal clothing specified in the Fifth Schedule;
- (iii) the skin or personal clothing of any other individual is contaminated in excess of 2.5 times the appropriate permitted contamination limits for skin or personal clothing specified in the Fifth Schedule;
- (iv) any area in the premises where work with ionising radiation or radioactive material is conducted is contaminated in excess of 50 times the permitted contamination limit for surfaces in such an area as specified in the Fifth Schedule; or
- (v) any other area is contaminated in excess of 10 times the permitted contamination limit for surfaces in low level laboratories as specified in the Fifth Schedule.

(2) For the purposes of this Part, a radiation accident shall be considered to have occurred in medical applications of ionising radiation or radioactive materials if there is an occurrence that involves the misuse of irradiating apparatus or maladministration of a radioactive material for medical purposes including —

- (a) any therapeutic treatment delivered —
  - (i) to the wrong patient or to the wrong tissue of any patient;
  - (ii) using the wrong radiopharmaceutical; or
  - (iii) with a dose or dose fractionation which differs by more than 10% from the value prescribed by the medical practitioner or which may lead to acute effects;
- (b) any diagnostic exposure greater than 50% of the intended dose or resulting in doses repeatedly or substantially exceeding the established normal doses for diagnostic radiological examinations; or
- (c) any equipment failure, error, mishap or other unusual occurrence which has the potential to cause a patient to receive a dose significantly different from that intended.

### **Radiation accident in non-medical application**

**50.**—(1) When any radiation accident occurs in a non-medical application of ionising radiation or radioactive materials, the licensee, the radiation safety officer or the individual in charge of the area at the time shall —

- (a) evacuate all individuals from the affected area;
- (b) block off the affected area and post warning signs at all its entrances;
- (c) take immediate action to reduce the hazards caused by the radiation accident;
- (d) make arrangements to provide temporary shielding, monitor and decontaminate any affected individual and the area and take all other actions necessary to return the situation to normal;
- (e) ensure that any contamination in excess of the appropriate permitted contamination limit for skin and clothing of any individual is removed before the individual leaves the premises;
- (f) ensure that any personal clothing or other private property which is contaminated by radioactive materials is not taken from the premises or released to a public laundry until it can be shown that the contamination does not exceed the appropriate permitted contamination limit; and
- (g) refer affected individuals for medical observation and treatment.

(2) The licensee or the radiation safety officer shall inform the Chief Executive of the occurrence of the accident by means of a preliminary oral report within 24 hours, which is to be confirmed in writing within 48 hours and a final full written report within 10 days.

(3) The preliminary written report shall where possible contain and the final full written report shall contain details of —

- (a) the time, place and nature of the accident, the number of individuals affected and the manner in which they were affected and the period during which there was loss of control of ionising radiation or of radioactive material;
- (b) the area over which any radioactive substance may have been dispersed and the degree of contamination;
- (c) the actions taken to rectify the accident situation and to minimise the possibility of any future recurrence;
- (d) any individual who may have suffered radiation exposure and the assessment of the effective or committed effective radiation doses received by the individual; and
- (e) the results of medical examinations carried out on affected individuals and, in the case of any internal exposure of individuals, the results of biological monitoring.

### **Radiation accident in medical application**

**51.**—(1) When any radiation accident occurs in a medical application of ionising radiation or radioactive material, the licensee or the radiation safety officer shall inform the Chief Executive of the occurrence of the accident by means of a preliminary oral report within 24 hours, which is to be confirmed in writing within 48 hours and a final full written report within 10 days.

(2) The preliminary written report shall where possible contain and the final full written report shall contain details of —

- (a) the accident and the patient involved;
- (b) the calculated or estimated doses received and their distribution within the patient; and
- (c) the corrective measures taken to prevent recurrence of a similar accident.

## **PART XVII**

## MISCELLANEOUS

### Responsibility of licensee

**52.**—(1) Every licensee shall ensure that he and every radiation worker employed by him or under his supervision comply with the provisions of these Regulations.

(2) Except as provided by regulation 53(6), every licensee authorised to use any irradiating apparatus or any radioactive substance for any purpose shall be responsible for the radiation safety in any work he is licensed to do.

(3) All work with any irradiating apparatus or any radioactive substance performed in any place by any individual other than the licensee shall be performed under the direction of the licensee or the radiation safety officer (if any) appointed by the licensee in accordance with regulation 53.

(4) Where a licensee is aware that a fault or defect exists or is suspected to exist in any irradiating apparatus or apparatus containing a sealed radioactive source, he shall —

- (a) immediately investigate the apparent fault or defect and, if necessary, cause the apparatus to be shut down, removed from service, repaired or replaced; and
- (b) inform all individuals who may have been exposed to radiation from the apparatus that they may have been so exposed in amounts in excess of those they would normally receive from the apparatus when in faultless condition.

(5) Where a licensee is aware that a fault or defect exists or is suspected to exist in any engineering control equipment (such as extract ventilation, a fume cupboard or a glove box) used to ensure safe working conditions in the use of unsealed radioactive materials, he shall —

- (a) immediately investigate the apparent fault or defect and, if necessary, cause the equipment to be shut down, removed from service, replaced or repaired;
- (b) inform all individuals who may have been exposed to radioactive materials as a result of the fault or defect; and
- (c) cause appropriate biological monitoring to be carried out for all individuals so exposed.

### Appointment of radiation safety officer

**53.**—(1) A licensee may, subject to the approval of the Chief Executive, appoint an

individual, who has satisfactorily undertaken a course of study in the use of radiation monitoring equipment and the principles of radiation safety or has equivalent experience as a radiation safety officer for the purposes of the supervision of the use or custody of any irradiating apparatus or radioactive substance for any work he is licensed to do.

(2) Any licensee who intends to appoint a radiation safety officer or deputy radiation safety officer shall submit a proposal of such appointment in writing to the Chief Executive together with the particulars, qualifications and experience of the individual whom he proposes to appoint as such radiation safety officer.

(3) The Chief Executive may, if he sees fit, approve the appointment of any individual as a radiation safety officer or deputy radiation safety officer either generally or in respect of any particular place or premises or part of any premises or in respect of any particular work.

(4) No individual shall act as a radiation safety officer or deputy radiation safety officer unless the Chief Executive has approved his appointment as a radiation safety officer or deputy radiation safety officer.

(5) The Chief Executive may, at any time, in his discretion, rescind his approval of the appointment of any individual as a radiation safety officer or deputy radiation safety officer.

(6) In the absence of the licensee, the radiation safety officer or deputy radiation safety officer shall be responsible for the radiation safety in any work performed under his supervision.

### **Prohibition of use of premises and irradiating apparatus or radioactive materials**

**54.**—(1) The Chief Executive may prohibit the use of any premises or part of any premises if, in his opinion, the use of such premises or part of such premises is likely to result in the receiving by any individual of an excessive radiation dose unnecessarily.

(2) The Chief Executive may prohibit the use of any irradiating apparatus or radioactive material if, in his opinion, the use of such apparatus or radioactive material is likely to result in the receiving by any individual of an excessive radiation dose unnecessarily.

### **Calibration of monitors and dosimeters**

**55.** Any radiation area monitor used for any purpose in connection with these Regulations and any direct reading personal dosimeter used for the measurement of the dose received by an individual shall, not more than 12 months prior to such use, have been calibrated by a person approved by the Chief Executive as a qualified person for this purpose, and a valid certificate issued by such qualified person certifying that the

accuracy of the monitor or dosimeter is within acceptable limits shall be available for inspection by the Chief Executive or any person authorised by the Chief Executive.

## Penalty

**56.** Any person who contravenes any of the provisions of these Regulations shall be guilty of an offence and shall be liable on conviction to a fine not exceeding \$2,000 or to imprisonment for a term not exceeding 6 months or to both.

## Savings

**57.**—(1) Every individual who immediately before 1st February 2000 is registered as a radiation worker under the revoked Radiation Protection Regulations 1974 (G.N. No. S 246/74) shall be deemed to be registered as a radiation worker under these Regulations, and any certificate of registration for any specified period issued to such an individual under the revoked Radiation Protection Regulations 1974 shall be deemed to be issued under these Regulations and remain valid for so much of the period that falls after such commencement.

(2) Any approval or consent granted or given by the Chief Executive under any provision of the revoked Radiation Protection Regulations 1974 shall be deemed an approval or consent granted or given by the Chief Executive under the corresponding provision of these Regulations.

## FIRST SCHEDULE

Regulation 3(1) and (2)

### MAXIMUM ACTIVITIES AND ACTIVITY CONCENTRATIONS OF RADIONUCLIDES EXEMPTED FROM THE PROVISIONS OF THE ACT

Nuclide	Activity Concentration (Bq/gm)	Activity (Bq)	Nuclide	Activity concentration (Bq/g)	Activity (Bq)
H-3	$1 \times 10^6$	$1 \times 10^9$	Fe-52	$1 \times 10^1$	$1 \times 10^6$
Be-7	$1 \times 10^3$	$1 \times 10^7$	Fe-55	$1 \times 10^4$	$1 \times 10^6$
C-14	$1 \times 10^4$	$1 \times 10^7$	Fe-59	$1 \times 10^1$	$1 \times 10^6$
O-15	$1 \times 10^2$	$1 \times 10^9$	Co-55	$1 \times 10^1$	$1 \times 10^6$
F-18	$1 \times 10^1$	$1 \times 10^6$	Co-56	$1 \times 10^1$	$1 \times 10^5$
Na-22	$1 \times 10^1$	$1 \times 10^6$	Co-57	$1 \times 10^2$	$1 \times 10^6$
Na-24	$1 \times 10^1$	$1 \times 10^5$	Co-58	$1 \times 10^1$	$1 \times 10^6$



Si-31	1x 10 <sup>3</sup>	1 x 10 <sup>6</sup>	Co-58m	1x 10 <sup>4</sup>	1 x 10 <sup>7</sup>
P-32	1x 10 <sup>3</sup>	1 x 10 <sup>5</sup>	Co-60	1x 10 <sup>1</sup>	1 x 10 <sup>5</sup>
P-33	1x 10 <sup>5</sup>	1 x 10 <sup>8</sup>	Co-60m	1x 10 <sup>3</sup>	1 x 10 <sup>6</sup>
S-35	1x 10 <sup>5</sup>	1 x 10 <sup>8</sup>	Co-61	1x 10 <sup>2</sup>	1 x 10 <sup>6</sup>
Cl-36	1x 10 <sup>4</sup>	1 x 10 <sup>6</sup>	Co-62m	1x 10 <sup>1</sup>	1 x 10 <sup>5</sup>
Cl-38	1x 10 <sup>1</sup>	1 x 10 <sup>5</sup>	Ni-59	1x 10 <sup>4</sup>	1 x 10 <sup>8</sup>
Ar-37	1x 10 <sup>6</sup>	1 x 10 <sup>8</sup>	Ni-63	1x 10 <sup>5</sup>	1 x 10 <sup>8</sup>
Ar-41	1x 10 <sup>2</sup>	1 x 10 <sup>9</sup>	Ni-65	1x 10 <sup>1</sup>	1 x 10 <sup>6</sup>
K-40	1x 10 <sup>2</sup>	1 x 10 <sup>6</sup>	Cu-64	1x 10 <sup>2</sup>	1 x 10 <sup>6</sup>
K-42	1x 10 <sup>2</sup>	1 x 10 <sup>6</sup>	Zn-65	1x 10 <sup>1</sup>	1 x 10 <sup>6</sup>
K-43	1x 10 <sup>1</sup>	1 x 10 <sup>6</sup>	Zn-69	1x 10 <sup>4</sup>	1 x 10 <sup>6</sup>
Ca-45	1x 10 <sup>4</sup>	1 x 10 <sup>7</sup>	Zn-69m	1x 10 <sup>2</sup>	1 x 10 <sup>6</sup>
Ca-47	1x 10 <sup>1</sup>	1 x 10 <sup>6</sup>	Ga-72	1x 10 <sup>1</sup>	1 x 10 <sup>5</sup>
Sc-46	1x 10 <sup>1</sup>	1 x 10 <sup>6</sup>	Ge-71	1x 10 <sup>4</sup>	1 x 10 <sup>8</sup>
Sc-47	1x 10 <sup>2</sup>	1 x 10 <sup>6</sup>	As-73	1x 10 <sup>3</sup>	1 x 10 <sup>7</sup>
Sc-48	1x 10 <sup>1</sup>	1 x 10 <sup>5</sup>	As-74	1x 10 <sup>1</sup>	1 x 10 <sup>6</sup>
V-48	1x 10 <sup>1</sup>	1 x 10 <sup>5</sup>	As-76	1x 10 <sup>2</sup>	1 x 10 <sup>5</sup>
Cr-51	1x 10 <sup>3</sup>	1 x 10 <sup>7</sup>	As-77	1x 10 <sup>3</sup>	1 x 10 <sup>6</sup>
Mn-51	1x 10 <sup>1</sup>	1 x 10 <sup>5</sup>	Se-75	1x 10 <sup>2</sup>	1 x 10 <sup>6</sup>
Mn-52	1x 10 <sup>1</sup>	1 x 10 <sup>5</sup>	Br-82	1x 10 <sup>1</sup>	1 x 10 <sup>6</sup>
Mn-52m	1x 10 <sup>1</sup>	1 x 10 <sup>5</sup>	Kr-74	1x 10 <sup>2</sup>	1 x 10 <sup>9</sup>
Mn-53	1x 10 <sup>4</sup>	1 x 10 <sup>9</sup>	Kr-76	1x 10 <sup>2</sup>	1 x 10 <sup>9</sup>
Mn-54	1x 10 <sup>1</sup>	1 x 10 <sup>6</sup>	Kr-77	1x 10 <sup>2</sup>	1 x 10 <sup>9</sup>
Mn-56	1x 10 <sup>1</sup>	1 x 10 <sup>5</sup>	Kr-79	1x 10 <sup>3</sup>	1 x 10 <sup>5</sup>
Kr-81	1x 10 <sup>4</sup>	1 x 10 <sup>7</sup>	Tc-97	1x 10 <sup>3</sup>	1 x 10 <sup>8</sup>
Kr-83m	1 x 10 <sup>5</sup>	1 x 10 <sup>12</sup>	Tc-97m	1 x 10 <sup>3</sup>	1 x 10 <sup>7</sup>
Kr-85	1 x 10 <sup>5</sup>	1 x 10 <sup>4</sup>	Tc-99	1 x 10 <sup>4</sup>	1 x 10 <sup>7</sup>
Kr-85m	1 x 10 <sup>3</sup>	1 x 10 <sup>10</sup>	Tc-99m	1 x 10 <sup>2</sup>	1 x 10 <sup>7</sup>
Kr-87	1 x 10 <sup>2</sup>	1 x 10 <sup>9</sup>	Ru-97	1 x 10 <sup>2</sup>	1 x 10 <sup>7</sup>
Kr-88	1 x 10 <sup>2</sup>	1 x 10 <sup>9</sup>	Ru-103	1 x 10 <sup>2</sup>	1 x 10 <sup>6</sup>
Rb-86	1 x 10 <sup>2</sup>	1 x 10 <sup>5</sup>	Ru-105	1 x 10 <sup>1</sup>	1 x 10 <sup>6</sup>
Sr-85	1 x 10 <sup>2</sup>	1 x 10 <sup>6</sup>	Ru-106	1 x 10 <sup>2</sup>	1 x 10 <sup>5</sup>

Sr-85m	$1 \times 10^2$	$1 \times 10^7$	Rh-103m	$1 \times 10^4$	$1 \times 10^8$
Sr-87m	$1 \times 10^2$	$1 \times 10^6$	Rh-105	$1 \times 10^2$	$1 \times 10^7$
Sr-89	$1 \times 10^3$	$1 \times 10^6$	Pd-103	$1 \times 10^3$	$1 \times 10^8$
Sr-90	$1 \times 10^2$	$1 \times 10^4$	Pd-109	$1 \times 10^3$	$1 \times 10^6$
Sr-91	$1 \times 10^1$	$1 \times 10^5$	Ag-105	$1 \times 10^2$	$1 \times 10^6$
Sr-92	$1 \times 10^1$	$1 \times 10^6$	Ag-110m	$1 \times 10^1$	$1 \times 10^6$
Y-90	$1 \times 10^3$	$1 \times 10^5$	Ag-111	$1 \times 10^3$	$1 \times 10^6$
Y-91	$1 \times 10^3$	$1 \times 10^6$	Cd-109	$1 \times 10^4$	$1 \times 10^6$
Y-91m	$1 \times 10^2$	$1 \times 10^6$	Cd-115	$1 \times 10^2$	$1 \times 10^6$
Y-92	$1 \times 10^2$	$1 \times 10^5$	Cd-115m	$1 \times 10^3$	$1 \times 10^6$
Y-93	$1 \times 10^2$	$1 \times 10^5$	In-111	$1 \times 10^2$	$1 \times 10^6$
Zr-93	$1 \times 10^3$	$1 \times 10^7$	In-113m	$1 \times 10^2$	$1 \times 10^6$
Zr-95	$1 \times 10^1$	$1 \times 10^6$	In-114m	$1 \times 10^2$	$1 \times 10^6$
Zr-97	$1 \times 10^1$	$1 \times 10^5$	In-115m	$1 \times 10^2$	$1 \times 10^6$
Nb-93m	$1 \times 10^4$	$1 \times 10^7$	Sn-113	$1 \times 10^3$	$1 \times 10^7$
Nb-94	$1 \times 10^1$	$1 \times 10^6$	Sn-125	$1 \times 10^2$	$1 \times 10^5$
Nb-95	$1 \times 10^1$	$1 \times 10^6$	Sb-122	$1 \times 10^2$	$1 \times 10^4$
Nb-97	$1 \times 10^1$	$1 \times 10^6$	Sb-124	$1 \times 10^1$	$1 \times 10^6$
Nb-98	$1 \times 10^1$	$1 \times 10^5$	Sb-125	$1 \times 10^2$	$1 \times 10^6$
Mo-90	$1 \times 10^1$	$1 \times 10^6$	Te-123m	$1 \times 10^2$	$1 \times 10^7$
Mo-93	$1 \times 10^3$	$1 \times 10^8$	Te-125m	$1 \times 10^3$	$1 \times 10^7$
Mo-99	$1 \times 10^2$	$1 \times 10^6$	Te-127	$1 \times 10^3$	$1 \times 10^6$
Mo-101	$1 \times 10^1$	$1 \times 10^6$	Te-127m	$1 \times 10^3$	$1 \times 10^7$
Tc-96	$1 \times 10^1$	$1 \times 10^6$	Te-129	$1 \times 10^2$	$1 \times 10^6$
Tc-96m	$1 \times 10^3$	$1 \times 10^7$	Te-129m	$1 \times 10^3$	$1 \times 10^6$
Te-131	$1 \times 10^2$	$1 \times 10^5$	Ce-143	$1 \times 10^2$	$1 \times 10^6$
Te-131m	$1 \times 10^1$	$1 \times 10^6$	Ce-144	$1 \times 10^2$	$1 \times 10^5$
Te-132	$1 \times 10^2$	$1 \times 10^7$	Pr-142	$1 \times 10^2$	$1 \times 10^5$
Te-133	$1 \times 10^1$	$1 \times 10^5$	Pr-143	$1 \times 10^4$	$1 \times 10^6$
Te-133m	$1 \times 10^1$	$1 \times 10^5$	Nd-147	$1 \times 10^2$	$1 \times 10^6$
Te-134	$1 \times 10^1$	$1 \times 10^6$	Nd-149	$1 \times 10^2$	$1 \times 10^6$
I-123	$1 \times 10^2$	$1 \times 10^7$	Pm-147	$1 \times 10^4$	$1 \times 10^7$

I-125	$1 \times 10^3$	$1 \times 10^6$	Pm-149	$1 \times 10^3$	$1 \times 10^6$
I-126	$1 \times 10^2$	$1 \times 10^6$	Sm-151	$1 \times 10^4$	$1 \times 10^8$
I-129	$1 \times 10^2$	$1 \times 10^5$	Sm-153	$1 \times 10^2$	$1 \times 10^6$
I-130	$1 \times 10^1$	$1 \times 10^6$	Eu-152	$1 \times 10^1$	$1 \times 10^6$
I-131	$1 \times 10^2$	$1 \times 10^6$	Eu-152m	$1 \times 10^2$	$1 \times 10^6$
I-132	$1 \times 10^1$	$1 \times 10^5$	Eu-154	$1 \times 10^1$	$1 \times 10^6$
I-133	$1 \times 10^1$	$1 \times 10^6$	Eu-155	$1 \times 10^2$	$1 \times 10^7$
I-134	$1 \times 10^1$	$1 \times 10^5$	Gd-153	$1 \times 10^2$	$1 \times 10^7$
I-135	$1 \times 10^1$	$1 \times 10^6$	Gd-159	$1 \times 10^3$	$1 \times 10^6$
Xe-131m	$1 \times 10^4$	$1 \times 10^4$	Tb-160	$1 \times 10^1$	$1 \times 10^6$
Xe-133	$1 \times 10^3$	$1 \times 10^4$	Dy-165	$1 \times 10^3$	$1 \times 10^6$
Xe-135	$1 \times 10^3$	$1 \times 10^{10}$	Dy-166	$1 \times 10^3$	$1 \times 10^6$
Cs-129	$1 \times 10^2$	$1 \times 10^5$	Ho-166	$1 \times 10^3$	$1 \times 10^5$
Cs-131	$1 \times 10^3$	$1 \times 10^6$	Er-169	$1 \times 10^4$	$1 \times 10^7$
Cs-132	$1 \times 10^1$	$1 \times 10^5$	Er-171	$1 \times 10^2$	$1 \times 10^6$
Cs-134m	$1 \times 10^3$	$1 \times 10^5$	Tm-170	$1 \times 10^3$	$1 \times 10^6$
Cs-134	$1 \times 10^1$	$1 \times 10^4$	Tm-171	$1 \times 10^4$	$1 \times 10^8$
Cs-135	$1 \times 10^4$	$1 \times 10^7$	Yb-175	$1 \times 10^3$	$1 \times 10^7$
Cs-136	$1 \times 10^1$	$1 \times 10^5$	Lu-177	$1 \times 10^3$	$1 \times 10^7$
Cs-137	$1 \times 10^1$	$1 \times 10^4$	Hf-181	$1 \times 10^1$	$1 \times 10^6$
Cs-138	$1 \times 10^1$	$1 \times 10^4$	Ta-182	$1 \times 10^1$	$1 \times 10^4$
Ba-131	$1 \times 10^2$	$1 \times 10^6$	W-181	$1 \times 10^3$	$1 \times 10^7$
Ba-140	$1 \times 10^1$	$1 \times 10^5$	W-185	$1 \times 10^4$	$1 \times 10^7$
La-140	$1 \times 10^1$	$1 \times 10^5$	W-187	$1 \times 10^2$	$1 \times 10^6$
Ce-139	$1 \times 10^2$	$1 \times 10^6$	Re-186	$1 \times 10^3$	$1 \times 10^6$
Ce-141	$1 \times 10^2$	$1 \times 10^7$	Re-188	$1 \times 10^2$	$1 \times 10^5$
Os-185	$1 \times 10^1$	$1 \times 10^6$	Rn-222	$1 \times 10^1$	$1 \times 10^8$
Os-191	$1 \times 10^2$	$1 \times 10^7$	Ra-223	$1 \times 10^2$	$1 \times 10^5$
Os-191m	$1 \times 10^3$	$1 \times 10^7$	Ra-224	$1 \times 10^1$	$1 \times 10^5$
Os-193	$1 \times 10^2$	$1 \times 10^6$	Ra-225	$1 \times 10^2$	$1 \times 10^5$
Ir-190	$1 \times 10^1$	$1 \times 10^6$	Ra-226	$1 \times 10^1$	$1 \times 10^4$
Ir-192	$1 \times 10^1$	$1 \times 10^4$	Ra-227	$1 \times 10^2$	$1 \times 10^6$

Ir-194	$1 \times 10^2$	$1 \times 10^5$	Ra-228	$1 \times 10^1$	$1 \times 10^5$
Pt-191	$1 \times 10^2$	$1 \times 10^6$	Ac-228	$1 \times 10^1$	$1 \times 10^6$
Pt-193m	$1 \times 10^3$	$1 \times 10^7$	Th-226	$1 \times 10^3$	$1 \times 10^7$
Pt-197	$1 \times 10^3$	$1 \times 10^6$	Th-227	$1 \times 10^1$	$1 \times 10^4$
Pt-197m	$1 \times 10^2$	$1 \times 10^6$	Th-228	$1 \times 10^0$	$1 \times 10^4$
Au-198	$1 \times 10^2$	$1 \times 10^6$	Th-229	$1 \times 10^0$	$1 \times 10^3$
Au-199	$1 \times 10^2$	$1 \times 10^6$	Th-230	$1 \times 10^0$	$1 \times 10^4$
Hg-197	$1 \times 10^2$	$1 \times 10^7$	Th-231	$1 \times 10^3$	$1 \times 10^7$
Hg-197m	$1 \times 10^2$	$1 \times 10^6$	Th-nat	$1 \times 10^0$	$1 \times 10^3$
Hg-203	$1 \times 10^2$	$1 \times 10^5$	(incl.Th-232)		
Tl-200	$1 \times 10^1$	$1 \times 10^6$	Th-234	$1 \times 10^3$	$1 \times 10^5$
Tl-201	$1 \times 10^2$	$1 \times 10^6$	Pa-230	$1 \times 10^1$	$1 \times 10^6$
Tl-202	$1 \times 10^2$	$1 \times 10^6$	Pa-231	$1 \times 10^0$	$1 \times 10^3$
Tl-204	$1 \times 10^4$	$1 \times 10^4$	Pa-233	$1 \times 10^2$	$1 \times 10^7$
Pb-203	$1 \times 10^2$	$1 \times 10^6$	U-230	$1 \times 10^1$	$1 \times 10^5$
Pb-210	$1 \times 10^1$	$1 \times 10^4$	U-231	$1 \times 10^2$	$1 \times 10^7$
Pb-212	$1 \times 10^1$	$1 \times 10^5$	U-232	$1 \times 10^0$	$1 \times 10^3$
Bi-206	$1 \times 10^1$	$1 \times 10^5$	U-233	$1 \times 10^1$	$1 \times 10^4$
Bi-207	$1 \times 10^1$	$1 \times 10^6$	U-234	$1 \times 10^1$	$1 \times 10^4$
Bi-210	$1 \times 10^3$	$1 \times 10^6$	U-235	$1 \times 10^1$	$1 \times 10^4$
Bi-212	$1 \times 10^1$	$1 \times 10^5$	U-236	$1 \times 10^1$	$1 \times 10^4$
Po-203	$1 \times 10^1$	$1 \times 10^6$	U-237	$1 \times 10^2$	$1 \times 10^6$
Po-205	$1 \times 10^1$	$1 \times 10^6$	U-238	$1 \times 10^1$	$1 \times 10^4$
Po-207	$1 \times 10^1$	$1 \times 10^6$	U-nat	$1 \times 10^0$	$1 \times 10^3$
Po-210	$1 \times 10^1$	$1 \times 10^4$	U-239	$1 \times 10^2$	$1 \times 10^6$
At-211	$1 \times 10^3$	$1 \times 10^7$	U-240	$1 \times 10^3$	$1 \times 10^7$
Rn-220	$1 \times 10^4$	$1 \times 10^7$	U-240	$1 \times 10^1$	$1 \times 10^6$
Np-237	$1 \times 10^0$	$1 \times 10^3$	Cm-244	$1 \times 10^1$	$1 \times 10^4$
Np-239	$1 \times 10^2$	$1 \times 10^7$	Cm-245	$1 \times 10^0$	$1 \times 10^3$
Np-240	$1 \times 10^1$	$1 \times 10^6$	Cm-246	$1 \times 10^0$	$1 \times 10^3$
Pu-234	$1 \times 10^2$	$1 \times 10^7$	Cm-247	$1 \times 10^0$	$1 \times 10^4$
Pu-235	$1 \times 10^2$	$1 \times 10^7$	Cm-248	$1 \times 10^0$	$1 \times 10^3$

Pu-236	$1 \times 10^1$	$1 \times 10^4$	Bk-249	$1 \times 10^3$	$1 \times 10^6$
Pu-237	$1 \times 10^3$	$1 \times 10^7$	Cf-246	$1 \times 10^3$	$1 \times 10^6$
Pu-238	$1 \times 10^0$	$1 \times 10^4$	Cf-248	$1 \times 10^1$	$1 \times 10^4$
Pu-239	$1 \times 10^0$	$1 \times 10^4$	Cf-249	$1 \times 10^0$	$1 \times 10^3$
Pu-240	$1 \times 10^0$	$1 \times 10^3$	Cf-250	$1 \times 10^1$	$1 \times 10^4$
Pu-241	$1 \times 10^2$	$1 \times 10^5$	Cf-251	$1 \times 10^0$	$1 \times 10^3$
Pu-242	$1 \times 10^0$	$1 \times 10^4$	Cf-252	$1 \times 10^1$	$1 \times 10^4$
Pu-243	$1 \times 10^3$	$1 \times 10^7$	Cf-253	$1 \times 10^2$	$1 \times 10^5$
Pu-244	$1 \times 10^0$	$1 \times 10^4$	Cf-254	$1 \times 10^0$	$1 \times 10^3$
Am-241	$1 \times 10^0$	$1 \times 10^4$	Es-253	$1 \times 10^2$	$1 \times 10^5$
Am-242	$1 \times 10^3$	$1 \times 10^6$	Es-254	$1 \times 10^1$	$1 \times 10^4$
Am-242m	$1 \times 10^0$	$1 \times 10^4$	Es-254m	$1 \times 10^2$	$1 \times 10^6$
Am-243	$1 \times 10^0$	$1 \times 10^3$	Fm-254	$1 \times 10^4$	$1 \times 10^7$
Cm-242	$1 \times 10^2$	$1 \times 10^5$	Fm-255	$1 \times 10^3$	$1 \times 10^6$
Cm-243	$1 \times 10^0$	$1 \times 10^4$			

- (a) Exemption is given for radioactive substances for which either the total activity or the activity concentration of the radionuclide does not exceed the levels given in the above table.
- (b) In the case of more than one radionuclide, the appropriate sum of the ratios of the activity or activity concentration of each radionuclide and the corresponding exempt activity or activity concentration shall be taken into account.
- (c) Bulk amounts of materials with activity concentrations lower than the levels in the above table shall be individually considered by the Chief Executive.

## SECOND SCHEDULE

Regulations 2, 14(1), (4) and (5), 15(4), 16(1), (2) and (3), 18 and 49(1)

### PART I

#### DOSE LIMITS FOR RADIATION WORKERS

- (a) Except as provided in paragraph (d) of this Part, the dose limits for radiation workers shall be those given in the following table. The dose from any medical or dental exposure as a patient, from the exposure to natural background radiation or from other exposures received by the radiation worker as a member of the public shall not be taken into account.

Application	Dose limit per year (mSv)

Effective dose (whole body)	120
	<sup>1</sup> The limit on effective dose (whole body) is 20 mSv per year, average over defined periods of 5 years and with the further provision that the effective dose shall not exceed 50 mSv in any single year. The limit shall apply to the sum of the relevant doses from external exposure in the specified period and the committed effective dose.
Equivalent dose in the lens of the eye	150
<sup>2</sup> the skin	500
	<sup>2</sup> The limit of 500 mSv for skin is averaged over areas of no more than 1cm <sup>2</sup> regardless of the area exposed.
the hands and feet	500

(b) Where only a part or parts of the body are irradiated by external radiation, the effective dose received from external radiation shall be determined by calculating the sum of  $w_T H_T$  over all the organs and tissues irradiated, where —

- (i)  $H_T$  is the equivalent dose received by any particular tissue or organ T; and
- (ii)  $w_T$  is the weighting factor for that tissue or organ.

The values of the tissue weighting factors to be used for determining the weighted equivalent dose  $w_T H_T$ , shall be those given in the following table:

Tissue or organ	Tissue weighting factor $w_T$
Gonads	0.20
Bone marrow( <i>red</i> )	0.12
Colon	0.12
Lung	0.12
Stomach	0.12
Bladder	0.05

Breast	0.05
Liver	0.05
Oesophagus	0.05
Thyroid	0.05
Skin	0.01
Bone surface	0.01
Remainder	<sup>3</sup> 0.05
	<sup>3</sup> The equivalent dose in the remainder is the estimated mean equivalent dose over the whole body excluding the specified tissues and organs.

- (c) The occupational dose limit for women who are not pregnant shall be the same as that of men.
- (d) Once pregnancy has been declared, the equivalent dose limit to the surface of the woman's abdomen (lower trunk) shall be 2 mSv for the remainder of the pregnancy and the intake of radionuclides shall be limited to one-twentieth of the ALI specified in the Third Schedule.

## PART II

### DOSE LIMITS FOR INDIVIDUAL MEMBERS OF THE PUBLIC

The annual dose limits for individual members of the public shall be those listed in the following table. The dose from any medical or dental exposure as a patient or from the exposure to natural background radiation shall not be taken into account.

Application	Dose limit per year (mSv)
Effective dose (whole body)	<sup>4</sup> 1
Equivalent dose in the lens of the eye	15
	<sup>4</sup> In special circumstances, a higher value of effective dose for the whole body could be allowed in a single year, provided that the average over 5 years does not exceed 1 mSv per year. The limit shall apply to the sum of the relevant doses from external exposure in the specified period and the committed effective dose.

<sup>5</sup> the skin  <sup>5</sup> The limit of 50 mSv for skin is averaged over areas of no more than 1 cm <sup>2</sup> regardless of the area exposed.	50
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### PART III

#### VALUES OF RADIATION WEIGHTING FACTOR FOR DIFFERENT TYPES OF IONISING RADIATION

The values of radiation weighting factor to be used in determining the equivalent dose in a tissue or organ shall be those given in the following table. All values relate to the radiation incident on the body or, for internal sources, emitted from the source.

Type of ionising radiation and energy range	Radiation weighting factor
Photons, all energies	1
Electrons and muons, all energies	1
Neutrons, energy < 10 keV	5
10 keV to 100 keV	10
>100 keV to 2 MeV	20
>2 MeV to 20 MeV	10
>20 MeV	5
Protons, other than recoil protons, energy >2 MeV	5
Alpha particles, fission fragments, heavy nuclei	20

### THIRD SCHEDULE

Regulation 24(2) and Second Schedule (Part I)

#### ANNUAL LIMITS ON INTAKE (ALI) FOR RADIATION WORKERS

[Abbreviation: Metastable excited state (*m*)]

Column 1	Column 2	Column 3
Element (Atomic Number)	Isotope	Most Restrictive Inhalation ALI (Bq)
Hydrogen (1)	H 3	1 x 10 <sup>9</sup>
		Most Restrictive Ingestion ALI (Bq)
		1 x 10 <sup>9</sup>



Beryllium (4)	Be 7	$2 \times 10^8$	$6 \times 10^8$
Carbon (6)	C 14	$4 \times 10^7$	$4 \times 10^7$
Fluorine (9)	F 18	$9 \times 10^8$	$4 \times 10^8$
Sodium (11)	Na 22	$1 \times 10^7$	$7 \times 10^6$
	Na 24	$6 \times 10^7$	$5 \times 10^7$
Silicon (14)	Si 31	$4 \times 10^8$	$2 \times 10^8$
Phosphorus (15)	P 32	$5 \times 10^6$	$8 \times 10^6$
Sulphur (16)	S 35	$3 \times 10^7$	$7 \times 10^7$
Chlorine (17)	Cl 36	$3 \times 10^6$	$2 \times 10^7$
	Cl 38	$5 \times 10^8$	$2 \times 10^8$
Potassium (19)	K 42	$5 \times 10^7$	$5 \times 10^7$
Calcium (20)	Ca 45	$1 \times 10^7$	$2 \times 10^7$
	Ca 47	$1 \times 10^7$	$1 \times 10^7$
Scandium (21)	Sc 46	$3 \times 10^6$	$1 \times 10^7$
	Sc 47	$3 \times 10^7$	$3 \times 10^7$
	Sc 48	$2 \times 10^7$	$1 \times 10^7$
Vanadium (23)	V 48	$7 \times 10^6$	$8 \times 10^6$
Chromium (24)	Cr 51	$2 \times 10^8$	$4 \times 10^8$

Manganese (25)	Mn 52	$1 \times 10^7$	$1 \times 10^7$
	Mn 54	$1 \times 10^7$	$3 \times 10^7$
	Mn 56	$2 \times 10^8$	$9 \times 10^7$
Iron (26)	Fe 55	$3 \times 10^7$	$1 \times 10^8$
	Fe 59	$5 \times 10^6$	$1 \times 10^7$
Cobalt (27)	Co 57	$8 \times 10^6$	$6 \times 10^7$
	Co 58	$7 \times 10^6$	$2 \times 10^7$
	Co 58m	$8 \times 10^8$	$9 \times 10^8$
	Co 60	$4 \times 10^5$	$3 \times 10^6$
Nickel (28)	Ni 59	$3 \times 10^7$	$3 \times 10^8$
	Ni 63	$1 \times 10^7$	$1 \times 10^8$
	Ni 65	$2 \times 10^8$	$1 \times 10^8$
Copper (29)	Cu 64	$3 \times 10^8$	$2 \times 10^8$
Zinc (30)	Zn 65	$4 \times 10^6$	$5 \times 10^6$
	Zn 69	$2 \times 10^9$	$7 \times 10^8$
	Zn 69m	$9 \times 10^7$	$5 \times 10^7$
Gallium (31)	Ga 72	$4 \times 10^7$	$2 \times 10^7$
Germanium (32)	Ge 71	$6 \times 10^8$	$8 \times 10^9$
Arsenic (33)	As 73	$2 \times 10^7$	$8 \times 10^7$
	As 74	$9 \times 10^6$	$2 \times 10^7$
	As 76	$2 \times 10^7$	$1 \times 10^7$
	As 77	$6 \times 10^7$	$5 \times 10^7$
Selenium (34)	Se 75	$1 \times 10^7$	$9 \times 10^6$
Bromine (35)	Br 82	$5 \times 10^7$	$4 \times 10^7$
Rubidium (37)	Rb 86	$1 \times 10^7$	$8 \times 10^6$

	Rb 87	$2 \times 10^7$	$2 \times 10^7$
Strontium (38)	Sr 85	$4 \times 10^7$	$4 \times 10^7$
	Sr 85m	$9 \times 10^9$	$4 \times 10^9$
	Sr 89	$2 \times 10^6$	$6 \times 10^6$
	Sr 90	$6 \times 10^4$	$5 \times 10^6$
	Sr 91	$5 \times 10^7$	$3 \times 10^7$
	Sr 92	$1 \times 10^8$	$4 \times 10^7$
Yttrium (39)	Y 90	$7 \times 10^6$	$5 \times 10^6$
	Y 91	$1 \times 10^6$	$5 \times 10^6$
	Y 91m	$2 \times 10^9$	$2 \times 10^9$
	Y 92	$1 \times 10^8$	$4 \times 10^7$
	Y 93	$3 \times 10^7$	$2 \times 10^7$
Zirconium (40)	Zr 93	$1 \times 10^6$	$7 \times 10^7$
	Zr 95	$3 \times 10^6$	$2 \times 10^7$
	Zr 97	$2 \times 10^7$	$8 \times 10^6$
Niobium (41)	Nb 93m	$3 \times 10^6$	$1 \times 10^8$
	Nb 95	$1 \times 10^7$	$3 \times 10^7$
	Nb 97	$9 \times 10^8$	$4 \times 10^8$
Molybdenum (42)	Mo 99	$2 \times 10^7$	$1 \times 10^7$
Technetium (43)	Tc 96	$3 \times 10^7$	$2 \times 10^7$
	Tc 96m	$3 \times 10^9$	$2 \times 10^9$
	Tc 97	$7 \times 10^7$	$3 \times 10^8$
	Tc 97m	$1 \times 10^7$	$4 \times 10^7$
	Tc 99	$8 \times 10^6$	$3 \times 10^7$
	Tc 99m	$2 \times 10^9$	$1 \times 10^9$
	Ruthenium (44)	Ru 97	$2 \times 10^8$
Ru 103		$8 \times 10^6$	$2 \times 10^7$

	Ru 105	$2 \times 10^8$	$7 \times 10^7$
	Ru 106	$2 \times 10^5$	$2 \times 10^6$
Rhodium (45)	Rh 103m	$1 \times 10^{10}$	$6 \times 10^9$
	Rh 105	$7 \times 10^7$	$4 \times 10^7$
Palladium (46)	Pd 103	$4 \times 10^7$	$7 \times 10^7$
	Pd 109	$7 \times 10^7$	$3 \times 10^7$
Silver (47)	Ag 105	$2 \times 10^7$	$4 \times 10^7$
	Ag 110m	$1 \times 10^6$	$7 \times 10^6$
	Ag 111	$1 \times 10^7$	$1 \times 10^7$
Cadmium (48)	Cd 109	$1 \times 10^6$	$9 \times 10^6$
	Cd 115	$2 \times 10^7$	$1 \times 10^7$
	Cd 115m	$2 \times 10^6$	$5 \times 10^6$
Indium (49)	In 113m	$2 \times 10^9$	$9 \times 10^8$
	In 114m	$1 \times 10^6$	$3 \times 10^6$
	In 115	$3 \times 10^4$	$6 \times 10^5$
	In 115m	$6 \times 10^8$	$2 \times 10^8$
Tin (50)	Sn 113	$7 \times 10^6$	$2 \times 10^7$
	Sn 125	$4 \times 10^6$	$4 \times 10^6$
Antimony (51)	Sb 122	$1 \times 10^7$	$8 \times 10^6$
	Sb 124	$3 \times 10^6$	$6 \times 10^6$
	Sb 125	$6 \times 10^6$	$2 \times 10^7$
Tellurium (52)	Te 125m	$1 \times 10^7$	$2 \times 10^7$
	Te 127	$2 \times 10^8$	$1 \times 10^8$
	Te 127m	$4 \times 10^6$	$9 \times 10^6$
	Te 129	$8 \times 10^8$	$4 \times 10^8$
	Te 129m	$3 \times 10^6$	$5 \times 10^6$
	Te 131m	$8 \times 10^6$	$6 \times 10^6$

	Te 132	$5 \times 10^6$	$5 \times 10^6$
Iodine (53)	I 125	$2 \times 10^6$	$1 \times 10^6$
	I 126	$1 \times 10^6$	$6 \times 10^5$
	I 129	$3 \times 10^5$	$2 \times 10^5$
	I 131	$1 \times 10^6$	$8 \times 10^5$
	I 132	$1 \times 10^8$	$7 \times 10^7$
	I 133	$8 \times 10^6$	$4 \times 10^6$
	I 134	$5 \times 10^8$	$2 \times 10^8$
	I 135	$4 \times 10^7$	$2 \times 10^7$
	Cesium (55)	Cs 131	$5 \times 10^8$
Cs 134		$2 \times 10^6$	$1 \times 10^6$
Cs 134m		$2 \times 10^9$	$1 \times 10^9$
Cs 135		$2 \times 10^7$	$1 \times 10^7$
Cs 136		$1 \times 10^7$	$7 \times 10^6$
Cs 137		$2 \times 10^6$	$1 \times 10^6$
Barium (56)	Ba 131	$1 \times 10^8$	$4 \times 10^7$
	Ba 140	$2 \times 10^7$	$6 \times 10^6$
Lanthanum (57)	La 140	$1 \times 10^7$	$8 \times 10^6$
Cerium (58)	Ce 141	$8 \times 10^6$	$2 \times 10^7$
	Ce 143	$2 \times 10^7$	$1 \times 10^7$
	Ce 144	$2 \times 10^5$	$2 \times 10^6$
Praseodymium (59)	Pr 142	$2 \times 10^7$	$1 \times 10^7$
	Pr 143	$8 \times 10^6$	$1 \times 10^7$
Neodymium (60)	Nd 147	$1 \times 10^7$	$1 \times 10^7$
	Nd 149	$3 \times 10^8$	$1 \times 10^8$
Promethium (61)	Pm 147	$2 \times 10^6$	$5 \times 10^7$
	Pm 149	$2 \times 10^7$	$1 \times 10^7$

Samarium (62)	Sm 147	2000	$6 \times 10^5$
	Sm 151	$4 \times 10^6$	$1 \times 10^8$
	Sm 153	$3 \times 10^7$	$2 \times 10^7$
Europium (63)	Eu 152	$4 \times 10^5$	$1 \times 10^7$
	Eu 152m	$9 \times 10^7$	$4 \times 10^7$
	Eu 154	$3 \times 10^5$	$7 \times 10^6$
	Eu 155	$3 \times 10^6$	$4 \times 10^7$
Gadolinium (64)	Gd 152	500	$8 \times 10^5$
	Gd 153	$5 \times 10^6$	$5 \times 10^7$
	Gd 159	$7 \times 10^7$	$3 \times 10^7$
Terbium (65)	Tb 160	$3 \times 10^6$	$9 \times 10^6$
Dysprosium (66)	Dy 165	$6 \times 10^8$	$2 \times 10^8$
	Dy 166	$8 \times 10^6$	$7 \times 10^6$
Holmium (67)	Ho 166	$2 \times 10^7$	$1 \times 10^7$
Erbium (68)	Er 169	$3 \times 10^7$	$3 \times 10^7$
	Er 171	$1 \times 10^8$	$5 \times 10^7$
Thulium (69)	Tm 170	$3 \times 10^6$	$1 \times 10^7$
	Tm 171	$1 \times 10^7$	$1 \times 10^8$
Ytterbium (70)	Yb 175	$4 \times 10^7$	$3 \times 10^7$
Lutetium (71)	Lu 177	$3 \times 10^7$	$2 \times 10^7$
Hafnium (72)	Hf 181	$6 \times 10^6$	$1 \times 10^7$
Tantalum (73)	Ta 182	$2 \times 10^6$	$9 \times 10^6$
Tungsten (74)	W 181	$6 \times 10^8$	$2 \times 10^8$
	W 185	$1 \times 10^8$	$3 \times 10^7$
	W 187	$1 \times 10^8$	$2 \times 10^7$
Rhenium (75)	Re 183	$2 \times 10^7$	$2 \times 10^7$
	Re 186	$2 \times 10^7$	$2 \times 10^7$

	Re 187	$1 \times 10^9$	$5 \times 10^9$
	Re 188	$3 \times 10^7$	$2 \times 10^7$
Osmium (76)	Os 185	$8 \times 10^6$	$3 \times 10^7$
	Os 191	$2 \times 10^7$	$2 \times 10^7$
	Os 191m	$2 \times 10^8$	$2 \times 10^8$
	Os 193	$3 \times 10^7$	$2 \times 10^7$
Iridium (77)	Ir 190	$1 \times 10^7$	$1 \times 10^7$
	Ir 192	$3 \times 10^6$	$1 \times 10^7$
	Ir 194	$2 \times 10^7$	$1 \times 10^7$
Platinum (78)	Pt 191	$1 \times 10^8$	$5 \times 10^7$
	Pt 193	$5 \times 10^8$	$4 \times 10^8$
	Pt 193m	$9 \times 10^7$	$3 \times 10^7$
	Pt 197	$1 \times 10^8$	$4 \times 10^7$
	Pt 197m	$6 \times 10^8$	$2 \times 10^8$
Gold (79)	Au 198	$2 \times 10^7$	$1 \times 10^7$
	Au 199	$4 \times 10^7$	$3 \times 10^7$
Mercury (80)	Hg 197	$1 \times 10^8$	$6 \times 10^7$
	Hg 197m	$6 \times 10^7$	$3 \times 10^7$
	Hg 203	$1 \times 10^7$	$1 \times 10^7$
Thallium (81)	Tl 200	$2 \times 10^8$	$1 \times 10^8$
	Tl 201	$4 \times 10^8$	$3 \times 10^8$
	Tl 202	$8 \times 10^7$	$5 \times 10^7$
	Tl 204	$4 \times 10^7$	$3 \times 10^7$
Lead (82)	Pb 203	$2 \times 10^8$	$6 \times 10^7$
	Pb 210	$1 \times 10^4$	$2 \times 10^4$
	Pb 212	$5 \times 10^5$	$2 \times 10^6$
Bismuth (83)	Bi 206	$1 \times 10^7$	$9 \times 10^6$

	Bi 207	$4 \times 10^6$	$1 \times 10^7$
	Bi 210	$4 \times 10^5$	$1 \times 10^7$
	Bi 212	$4 \times 10^6$	$9 \times 10^7$
Polonium (84)	Po 210	$1 \times 10^4$	$9 \times 10^4$
Astatine (85)	At 211	$7 \times 10^5$	$2 \times 10^6$
Radium (88)	Ra 223	$1 \times 10^4$	$2 \times 10^5$
	Ra 224	$2 \times 10^4$	$3 \times 10^5$
	Ra 226	9000	$9 \times 10^4$
	Ra 228	$2 \times 10^4$	$7 \times 10^4$
Actinium (89)	AC 227	20	9000
	AC 228	$4 \times 10^5$	$4 \times 10^7$
Thorium (90)	Th 227	5000	$2 \times 10^6$
	Th 228	200	$3 \times 10^5$
	Th 230	400	$3 \times 10^5$
	Th 231	$8 \times 10^7$	$5 \times 10^7$
	Th 232	90	$5 \times 10^4$
	Th 234	$2 \times 10^6$	$4 \times 10^6$
Protactinium (91)	Pa 230	$5 \times 10^4$	$1 \times 10^7$
	Pa 231	100	$1 \times 10^4$
	Pa 233	$7 \times 10^6$	$2 \times 10^7$
Uranium (92)	U 230	4000	$2 \times 10^5$
	U 232	100	$2 \times 10^5$
	U 233	500	$7 \times 10^5$
	U 234	600	$7 \times 10^5$
	U 235	600	$7 \times 10^5$
	U 236	600	$7 \times 10^5$
	U 238	600	$8 \times 10^5$



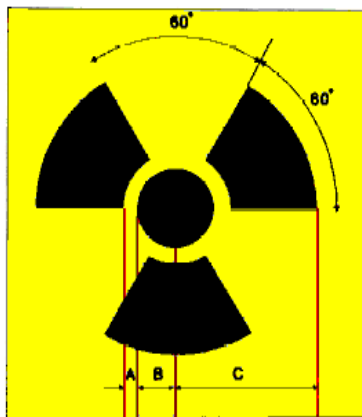
	U 240	$3 \times 10^7$	$2 \times 10^7$
Neptunium (93)	Np 237	300	$3 \times 10^4$
	Np 239	$3 \times 10^7$	$2 \times 10^7$
Plutonium (94)	Pu 238	300	$4 \times 10^4$
	Pu 239	300	$4 \times 10^4$
	Pu 240	300	$4 \times 10^4$
	Pu 241	$2 \times 10^4$	$2 \times 10^6$
	Pu 242	300	$4 \times 10^4$
	Pu 243	$5 \times 10^8$	$2 \times 10^8$
	Pu 244	300	$4 \times 10^4$
Americium (95)	Am 241	300	$3 \times 10^4$
	Am 242m	300	$4 \times 10^4$
	Am 242	$2 \times 10^6$	$5 \times 10^7$
	Am 243	300	$3 \times 10^4$
	Am 244	$7 \times 10^6$	$4 \times 10^4$
Curium (96)	Cm 242	6000	$9 \times 10^5$
	Cm 243	400	$5 \times 10^4$
	Cm 244	500	$6 \times 10^4$
	Cm 245	300	$3 \times 10^4$
	Cm 246	300	$3 \times 10^4$
	Cm 247	300	$4 \times 10^4$
	Cm 248	80	9000
	Cm 249	$6 \times 10^8$	$8 \times 10^8$
Berkelium (97)	Bk 249	$1 \times 10^5$	$1 \times 10^7$
	Bk 250	$2 \times 10^7$	$2 \times 10^8$
Californium (98)	Cf 249	200	$3 \times 10^4$
	Cf 250	400	$6 \times 10^4$

	Cf 251	200	$3 \times 10^4$
	Cf 252	500	$1 \times 10^5$
	Cf 253	$2 \times 10^4$	$7 \times 10^6$
	Cf 254	300	$3 \times 10^4$
Einsteinium (99)	Es 253	$2 \times 10^4$	$2 \times 10^6$
	Es 254m	$2 \times 10^5$	$3 \times 10^6$
	Es 254	3000	$4 \times 10^5$
Fermium (100)	Fm 254	$1 \times 10^6$	$5 \times 10^7$
	Fm 255	$3 \times 10^5$	$6 \times 10^6$

#### FOURTH SCHEDULE

Regulations 19(1), 20, 21(1),  
32(3) and 39(4)

#### STANDARD SYMBOL FOR DESIGNATING ANY IONISING RADIATION HAZARD



A : B : C = 1 : 2 : 10

Trefoil symbol shall be black in colour and background shall be yellow.

A : B : C = 1 : 2 : 10

Trefoil symbol shall be black in colour and background shall be yellow.

## FIFTH SCHEDULE

Regulations 47 (2), (3) and (4) and 49(1)

### PART I

#### LIMITS FOR CONTAMINATION OF SURFACES

Nuclide	Limit (Bq/cm <sup>2</sup> )	Nuclide	Limit (Bq/cm <sup>2</sup> )
Th-230	$10^{-1}$	Se-75	$10^2$
Th-232	$10^{-1}$	Rb-86	$10^2$
Pa-231	$10^{-1}$	Sr-89	$10^2$
U-232	$10^{-1}$	Y-90	$10^2$
Pu-238	$10^{-1}$	Ru-106	$10^2$
Pu-239	$10^{-1}$	Ag-110m	$10^2$
Am-241	$10^{-1}$	Cd-109	$10^2$
Cm-244	$10^{-1}$	Cd-115m	$10^2$
Sm-147	$10^{-0}$	In-113m	$10^2$
Sm-153	$10^{-0}$	Sb-124	$10^2$
Pb-210	$10^{-0}$	I-125	$10^2$
Po-210	$10^{-0}$	I-131	$10^2$
Ra-226	$10^{-0}$	Cs-134	$10^2$
Th-227	$10^{-0}$	Cs-137	$10^2$
Th-228	$10^{-0}$	La-140	$10^2$
U-234	$10^{-0}$	Pm-147	$10^2$
U-235	$10^{-0}$	Eu-152	$10^2$
U-236	$10^{-0}$	Eu-154	$10^2$
U-238	$10^{-0}$	Bi-210	$10^2$

Sr-90	$10^{-1}$	H-3	$10^3$
Ra-223	$10^{-1}$	C-14	$10^3$
Ra-224	$10^{-1}$	S-35	$10^3$
Na-24	$10^{-2}$	Cl-36	$10^3$
P-32	$10^{-2}$	Ca-45	$10^3$
Co-56	$10^{-2}$	Ca-47	$10^3$
Co-60	$10^{-2}$	Sc-46	$10^3$
Cu-64	$10^{-2}$	Sc-47	$10^3$
Cu-65	$10^{-2}$	Cr-51	$10^3$
Zn-65	$10^{-2}$	Mn-54	$10^3$
Ga-68	$10^{-2}$	Fe-55	$10^3$
Fe-59	$10^{-3}$	Cs-129	$10^3$
Co-57	$10^{-3}$	Cs-131	$10^3$
Co-58	$10^{-3}$	Ba-133	$10^3$
Ni-63	$10^{-3}$	Ce-139	$10^3$
Ga-67	$10^{-3}$	Ce-141	$10^3$
Ge-68	$10^{-3}$	Nd-147	$10^3$
Br-77	$10^{-3}$	Gd-153	$10^3$
Rb-81	$10^{-3}$	Tb-160	$10^3$
Sr-85	$10^{-3}$	Eb-169	$10^3$
Sr-87	$10^{-3}$	Tm-170	$10^3$
Y-87	$10^{-3}$	Yb-169	$10^3$
Y-88	$10^{-3}$	Lu-177	$10^3$
Mo-99	$10^{-3}$	Hf-181	$10^3$
Tc-99m	$10^{-3}$	W-185	$10^3$
Tc-99	$10^{-3}$	Re-186	$10^3$

Ru-103	$10^{-3}$	Ir-192	$10^3$
Ag-111	$10^{-3}$	Au-196	$10^3$
In-111	$10^{-3}$	Hg-197	$10^3$
Sn-113	$10^{-3}$	Hg-203	$10^3$
Sb-125	$10^{-3}$	Tl-201	$10^3$
I-123	$10^{-3}$	Tl-204	$10^3$
All other alpha emitters with a half life > 3 months	$10^1$	All other non-alpha emitters	$10^2$

## PART II

### MODIFYING FACTORS FOR VARIOUS SURFACES

Surface contamination levels shall at all times be kept as low as reasonably achievable and shall not exceed those designated. The contamination limits in Part I are those for surfaces in low level laboratories. Modifying factors for other surfaces are given below.

Surface	Modifying Factor
Low level laboratories	1
Medium level laboratories	5
High level laboratories	10
Glove box interiors	10
Fume cupboard interiors	5
Skin (radiation workers)	1
Protective clothing	1
Personal clothing	0.05
Non-radioactive areas	0.05

*[G.N. Nos. S 29/2000; S 229/2000; S 195/2001]*

## LEGISLATIVE HISTORY

### RADIATION PROTECTION (IONISING RADIATION) REGULATIONS

(CHAPTER 262, RG 2)

This Legislative History is provided for the convenience of users of the Radiation Protection (Ionising Radiation) Regulations. It is not part of these Regulations.

**1. G. N. No. S 29/2000—Radiation Protection (Ionising Radiation) Regulations 2000**

Date of commencement : 1 February 2000

**2. G. N. No. S 229/2000—Radiation Protection (Ionising Radiation) (Amendment) Regulations 2000**

Date of commencement : 1 July 2000

**3. G. N. No. S 195/2001—Radiation Protection (Ionising Radiation) (Amendment) Regulations 2001**

Date of commencement : 1 April 2001

**4. 2001 Revised Edition—Radiation Protection (Ionising Radiation) Regulations**

Date of operation : 15 September 2001